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The Biostratigraphy of the Delaware Limestone (Middle Devonian) of Southwestern Ontario

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THE BIOSTRATIGRAPHY OF THE DELAWARE LIMESTONE

(MIDDLE DEVONIAN) OF SOUTHWESTERN ONTARIO

by

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THE BIOSTRATIGRAPHY OF THE DELAWARE LIMESTONE

(MIDDLE DEVONIAN) OF SOUTHWESTERN ONTARIO

Robert Francis Diffendal, Jr., Ph.D.

University of Nebraska, 1971

Adviser: J. A. Fagerstrom

The Delaware Limestone of Middle Devonian age crops out along two belts in southwestern Ontario. All but one of the major outcrops studied occur in the easternmost of these belts.

Examination of thin-sections and polished slabs of 254 samples collected at vertical intervals of one foot from 19 localities has led to delineation of four major microfacies within the formation. The basal quartzose microfacies, characteristically containing well-rounded, quartz sand, is present in the basal two to four feet of the formation. In the northwestern part of the eastern outcrop belt the predominant microfacies above the basal quartzose microfacies is partially recrystallized limestone. The primary microfacies to the southeast at St. Mary's, Ontario, is the biomicrite microfacies. The biomicrite microfacies grades vertically and laterally to the southeast into the burrowed biomicrite and biomicrite microfacies.

A total of 128 species have been obtained from the Delaware Limestone in Ontario. Of these, one species of charophyte, 10 species of arenaceous foraminifera, and 19 species of fish are reported for the first time from the formation in Ontario.

The characteristic brachiopods, *Martiniopsis* ? *maia* (Billings), *Brevispirifer lucasensis* (Stauffer) and *Spinatrypa spinosa* (Hall) are discussed in detail. The interiors of *M.* ? *maia* and *B. lucasensis* are described for the first time.

With the exception of *Tasmanites* sp., *Astraeospongium* spp., *Spinatrypa spinosa*, *Brevispirifer lucasensis*, *Polygnathus linguiformis linguiformis*, *Cheiracanthoides comptus*, and *Onychodus sigmoides*, the taxa of the Delaware Limestone are restricted to one or two of the major microfacies. None of the taxa collected occurs at all of the localities sampled.

Three biostratigraphic zones are recognized in the Delaware Limestone of southwestern Ontario. From the base of the formation upward they are the *Icriodus latericrescens* n. subsp. A Zone, the "lower spore zone", and the "upper spore zone". The two spore zones are informal zones based on the occurrence of two different sizes of spores belonging to the genus *Tasmanites*.

The *Icriodus latericrescens* n. subsp. A Zone occurs along the eastern outcrop belt from St. Mary's, Ontario, southeastward to Lake Erie. The "lower spore zone" can be recognized along the entire eastern outcrop belt. The "upper spore zone" is found only at St. Mary's, Ontario.

Only seven of the 128 species (*Icriodus latericrescens* n. subsp. A, *I. angustus*, *Hexagonaria truncata*, *Martiniopsis* ? *maia*, *Brevispirifer lucasensis*, *Spinatrypa spinosa*, and *Spinulicosta spinulicosta*) collected from the Delaware Limestone are of use in correlation of the formation with other units in adjacent portions of the United States.

On the basis of the occurrence of one or more of the species mentioned above and the reported presence of the Tioga Bentonite, a key marker bed, in the subsurface of southwestern Ontario, the Delaware Limestone outcrops in Ontario are correlated with the lower portions of the Dundee Limestone of Michigan and Ohio, and the Delaware Limestone of central Ohio. The exposed part of the formation is also correlated with the upper Jeffersonville and lower North Vernon Limestones of Indiana, the upper Grand Tower Limestone and lower Lingle Limestone of Illinois, the Seneca Member of the Onondaga Formation and the lower part of the Cherry Valley Member of the Marcellus Formation in New York. Exact correlation of the upper unexposed portions of the Delaware Limestone in Ontario can not be made at this time because the fossils from these rocks have not been studied adequately.

The base of the formation transgresses zonal boundaries along the eastern outcrop belt in a northwesterly direction indicating tentatively that the Delaware Limestone may be a time transgressive formation.

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INTRODUCTION

Purpose of Study

The purpose of this study is to determine the stratigraphic and geographic distribution of fossil taxa and major lithologic units within the Delaware Limestone in southwestern Ontario and from these data to establish a succession of biostratigraphic zones for use in local, regional, and intercontinental correlation. Samples of rocks and fossils were collected from quarries and natural exposures during the summers of 1965-1968 and 1970. The rocks were studied in detail in the laboratory by examination of thin-sections, polished slabs, and insoluble residues. The fossils were separated from the matrix by various procedures and identified.

Previous Work

Ohio

The Delaware Limestone was first described by Orton (1878, p. 606) from exposures located within the city of Delaware, Delaware county, Ohio. The designated type section of the formation according to Westgate (1926, p. 27) "...is at the quarry in the south bank of the Delaware Run, just east of the Hocking Valley Railroad". At present this railroad line is a part of the Chesapeake and Ohio Railroad. The quarry is no longer active and has been turned into a public park. Exposures of the limestone are still good and can be examined with ease.

Prior to the description of the Delaware Limestone by Orton the rocks of the area had been studied, described, and designated with a variety of names by various workers based on lithologic divisions that often overlapped. An excellent account of early work done on the Middle Devonian rocks of central Ohio can be found in Prosser (1905, pp. 413-442).

In 1909 C. R. Stauffer published a detailed report on the Middle Devonian of Ohio. This work is the standard reference on this aspect of the geology of central Ohio. The name Delaware Limestone has remained essentially unchanged from Stauffer's usage until the present time.

Michigan

In Michigan, rocks later recognized as equivalent in age to the Delaware Limestone of Ohio were designated the Dundee Limestone by M. A. Wadsworth in his field notes. Wadsworth died in 1888 before he could publish a description of the unit. A. C. Lane (1895, pp. 25-26) later described the formation in a general way using Wadsworth's notes. The formation as defined was based on exposures at Dundee, Monroe county, Michigan which are no longer accessible. Bassett (1935) and Ehlers and others (1952) have added additional data on the paleontology and stratigraphy of this formation.

Ontario

The history of nomenclatural changes that led up to the designation of the rocks studied in this report as the Delaware Limestone is long and complex. It can be understood most fully by referring to Text-figure 1. Although other names had been applied to the formation by earlier workers, probably the best place to begin this discussion is with the work in Ontario by C. R. Stauffer (1915). Stauffer reviewed the earlier work done in the area and recognized the Delaware Limestone in the Ontario sequence for the first time. He thought that the Delaware was underlain by an equivalent of the Onondaga Limestone of New York.

Bassett (1935, pp. 437, 442-43) said that the Dundee Limestone of Michigan could be correlated with the upper part of the Onondaga Limestone at Amherstburg, Ontario, because of lithologic and paleontologic similarity. He did not suggest that the designation of the rocks at Amherstburg should be changed to Dundee although Best (1953, p. 9) states that he did.

Caley (1940, pp. 87-94) called some of the rocks exposed along Lake Erie on the Niagara Peninsula the Onondaga Formation. Although Stauffer (1915) designated some of these strata as the Delaware Limestone, Caley (1940, p. 89) felt that he did not have enough surface or subsurface data to differentiate the two units.

In 1941 Caley (p. 49) proposed the name Norfolk Formation for rocks in the area from Innerkip, Ontario, westward as far as Thamesford that had previously been called Delaware and Onondaga Limestone plus any underlying conformable strata. Although his geologic map included rocks now known to belong to the Detroit River Group in the Norfolk Formation, Caley (p. 49) did point out that the relationship between these rocks and the overlying "true" Norfolk strata was unclear in the map area and that the Detroit River Group might be separated from the Norfolk by an unconformity. He suggested that if this was found to be true the Detroit River Group would be pre-Norfolk.

Later Caley (1945) described the surface and subsurface geology of the Windsor-Sarnia area of Essex county. He called the rocks in the area previously designated the Onondaga and Delaware Limestone by Stauffer the Norfolk Formation. Caley used the original formation definition in this area because there is a definite break between the Detroit River Group and the overlying rocks of the Norfolk.

In the same year Ehlers (in Landes, and others, 1945, pp. 118-119) designated the rocks above the Detroit River Group at Amherstburg and Goderich, Ontario, the Dundee Limestone. This designation was based upon the co-occurrence of presumably common index fossils (e.g., *Atrypa costata* and *Brevispirifer lucasensis*) between these strata and the type Dundee in Michigan. Furthermore, Ehlers (1945, p. 20) suggested that the Onondaga Limestone is stratigraphically below the Detroit River Group in these two areas rather than above it.

Best (1953) described the pre-Hamilton Devonian stratigraphy of southwestern Ontario. He reviewed the literature (pp. 4-12) and lumped Stauffer's Onondaga Formation with the Delaware Limestone in the St. Mary's, Goderich, Amherstburg, and the Niagara Peninsula areas, calling the rock the Delaware Limestone. He did maintain a two-fold division of the formation, however, by designating lower and upper members that were generally equivalent to Stauffer's two formational names (Onondaga, Delaware).

The name Dundee (Delaware) Formation was used by Caley and Liberty (1954) for the same rocks that Best had called Delaware. They thought (p. 226) that the unit rested unconformably on the Columbus Limestone or, where it was absent, the Detroit River Group.

After a reinvestigation of outcrops and well cuttings studied by Caley (1945) from Essex, Kent, and Lambton counties, Ontario, Sanford and Brady (1955, p. 7) changed the name Norfolk Formation to the Dundee Formation.

Ehlers and Stumm (1950) previously recognized the Columbus Limestone at the Chemical Lime Company Quarry at Ingersoll, Ontario. Later they published a more detailed report (1951) describing the strata at Ingersoll and listing the fauna present. Stumm, Kellum and Wright (1956, pp. 6-7) suggested that the lower 12 feet of the limestone exposed in the St. Mary's Cement Company Quarry at St. Mary's, Ontario might be equivalent to the Columbus Limestone of Ohio.

Stauffer (1957, p. 383) revised his scheme of 1915 to include new data. He changed his previous usage of the name Onondaga to the Columbus Limestone. By doing this the Delaware Limestone would be above the Columbus in Ontario. The Columbus in turn was thought to be stratigraphically above the Detroit River Group in southwestern Ontario except where the latter pinched out in the Niagara Peninsula. In that area the Columbus as used by Stauffer (1957) rested on the Onondaga.

Sanford (1967, pp. 985-987) called the Delaware Limestone of Best at the surface and in the subsurface, the Dundee Formation and correlated it with the Seneca and Moorehouse Members of the Onondaga Formation of New York. Sanford said that the Dundee "...gives way to...the Seneca and the Moorehouse Members of the Onondaga Formation." The main reasons for his correlation were the similarity in faunas between the Dundee Limestone of Michigan, the Ontario Dundee and the Delaware Limestone of Ohio and the continuity of the lithology seen on the surface with that in the subsurface. In 1969 Sanford revised the Geologic Map of southwestern Ontario by replacing the Delaware Limestone and Columbus Limestone designations shown on the previous geologic map of the area (Map 1062A) with the name Dundee Formation and Lucas Formation, respectively.

Text-Figure 1

Comparison of Formation Names Applied to the Delaware Limestone of Ontario

Stauffer 1915	Bassett 1935	Caley 1940	Caley 1941	Caley 1945	Ehlers 1945	Ehlers & Stumm 1951	Best 1953	Caley & Liberty 1954	Sanford & Brady 1955	Stumm & oth. 1956	Stauffer 1957	Sanford 1967	This Paper
Del										Del	Del		
Onon	Onon	Onon	Nor	Nor	Dun	Del	Del	Dun (Del)	Dun	Col ?	Col	Dun	Del
DR	DR		Nor or Pre-Nor	Pre-Nor	DR	Col	Col	Col	DR	Col		DR	"Col"
						DR	DR	DR		DR	DR		DR

Col - Columbus Limestone
Del - Delaware Limestone
DR - Detroit River Group
Dun - Dundee Formation
Nor - Norfolk Formation
Onon - Onondaga Formation
oth. - others

Text Figure 2

Comparison of Interpretations of SW Ontario Rock Succession

Stauffer 1915	Caley 1945	Best 1953	Stumm and others 1956	Sanford 1967	This Paper
Hamilton Fm.	Hamilton Fm.	Hamilton Fm.	Hamilton Fm.	Hamilton Fm.	Hamilton Fm.
Delaware Ls.					
			Delaware Ls.		
	Norfolk Fm.	Delaware Ls.	Columbus Fm. ?	Dundee Fm.	Delaware Ls.
Onondaga Fm.		Columbus Fm.	Columbus Fm.		"Columbus Fm."
	Pre-Norfolk Fm.	Detroit River Gr.	Detroit River Gr.	Detroit River Gr.	Detroit River Gr.
		Bois Blanc Fm.	Bois Blanc Fm.	Bois Blanc Fm.	Bois Blanc Fm.
Oriskany Fm.		Oriskany Fm.	Oriskany Fm.	Oriskany Fm.	Oriskany Fm.
Silurian*	Silurian	Silurian	Silurian	Silurian	Silurian

* in part Detroit River Group

- - - - possible boundary

......unconformity

For the purposes of this report the name Delaware Limestone will be employed with the understanding that it includes the same strata as those called Dundee by Sanford (1967). Since the Delaware Limestone of Ontario is continuous with the Delaware of Ohio and since the Delaware designation has been used for a longer period of time in Ontario it is probably the best name to use for this rock formation in the province. Later discussion of the lithology and the faunal and floral content of the limestone will help to clarify the rationale behind the usage of this formation name. Text-figure 2 lists the terminology employed in some of the previous works mentioned and that used in this report.

ACKNOWLEDGEMENTS

Numerous persons helped the author during this study. Special thanks are given to Dr. J. A. Fagerstrom of the University of Nebraska who suggested the problem, critically reviewed the manuscript, and aided the author in many other ways. Dr. S. B. Treves helped in some X-ray analyses of limestone samples. Dr. Paul Krutak provided advice during the study of microfaunas. A. N. Gerken and J. M. Hillerud took some of the pictures and aided in photographing specimens. R. K. Pabian helped the author in identification of trilobites and crinoids. Dr. Gilbert Klapper verified some of the conodont identifications made in this paper.

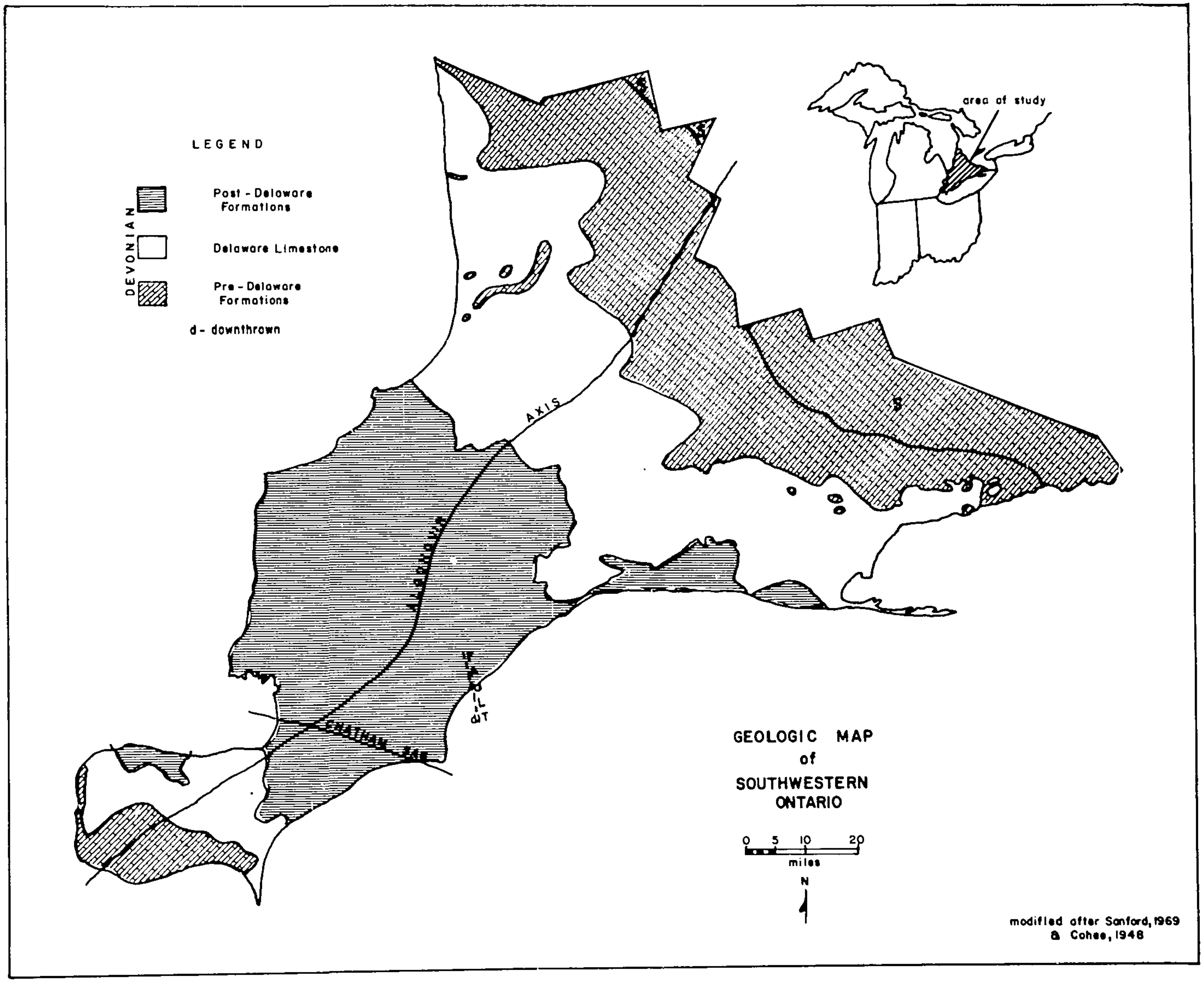
At the Geological Survey of Canada Dr. Bruce Sanford gave the author valuable advice regarding surface and subsurface relationships and provided valuable data from the Delaware Limestone. Dr. Thomas Bolton supplied locality numbers and information regarding fossils and loaned the author numerous specimens from the Delaware Limestone for study and comparison with collected material.

Dr. Gordon Winder of the University of Western Ontario, Geology Department gave the writer advice on the unit and provided data obtained by his students from local studies of the formation. Dr. A. C. Lenz loaned topotypes of *Martinia maia* for study.

Field work and travel were in part supported by funds provided by a Shell Fellowship in Geology (1964-65) and by funds from the University of Nebraska Graduate College Travel Grants (1966, 1968).

Special thanks are given to the operators of the active quarries at St. Mary's and Amherstburg, Ontario who allowed the writer to collect material used in this report.

Text-Fig. 3. Geologic Map of Southwestern Ontario


LEGEND
DEVONIAN
Post - Delaware Formations
Delaware Limestone
Pre - Delaware Formations
d - downthrown
area of study
AXIS
GEOLOGIC MAP
of
SOUTHWESTERN
ONTARIO
0 5 10 20
miles
N
modified after Sanford, 1969
& Cohee, 1948

STRUCTURE

Structural Features

The Delaware Limestone of southwestern Ontario crops out along the eastern flank of the Michigan Basin and is continuous across the Algonquin Axis into the Allegheny Synclinorium of the eastern United States (Kay, 1942, p. 1624). Text-figure 3 shows the two outcrop belts of the unit in Ontario as well as the positions of larger structural features on the peninsula. The separation of the outcrop belts is controlled by the position of the northwest-trending Chatham Sag (named by Kay, 1942), a down-warp across the Algonquin Axis.

Both Kay (1942, 1948) and Cohee (1948) recognized the Algonquin Axis in Ontario but Cohee tended to use the term synonomously with the Findlay Arch. Eardley (1951, pp. 36-37) called the arch the Findlay Arch on the basis of usage by earlier workers and personal communication with Cohee.

The Delaware Limestone of the eastern outcrop belt exhibits dips of a few degrees. At outcrops from St. Mary's, Ontario, northwestward to Port Albert this dip is generally to the west toward Lake Huron and the Michigan Basin. In the remainder of the outcrop belt the dip is generally toward Lake Erie. Across the Chatham Sag the rocks of the formation are nearly horizontal (Sanford, 1969, p. 997).

Local structures include a north-south trending, westward dipping monocline in the Devonian rocks at St. Mary's reported by Stauffer (1915, p. 113). Measurements of the elevation of the Delaware Limestone-Detroit

River contact at localities 85800 and 85801 by Dr. J. A. Fagerstrom using an altimeter support Stauffer's observaticn. There is a difference in elevation. The contact at locality 85800 is approximately 97 feet higher than the contact at locality 85801.

Caley (1945, pp. 50-52) recorded faults from the subsurface in the Windsor-Sarnia area and Sanford mapped one fault (see Text-figure 3) on the 1969 edition of the geologic map of southwestern Ontario.

Significance of the Structures

Evidence of thinning of the Delaware Limestone over the Algonquin Axis reported by Sanford (1967) is discussed in detail in a later section of this report. On the basis of Sanford's data the area along the Algonquin Axis was probably higher than adjacent areas during Delaware time. The more localized folds and faults probably were post-Delaware in origin.

STRATIGRAPHY

Units Below the Delaware Limestone in Ontario

As presently mapped by Sanford (1969) the Dundee (= Delaware of the present report) rests unconformably on the Detroit River Group over all of southwestern Ontario. Best (1953, p. 174) stated that the Delaware was underlain by the Columbus Limestone, Detroit River Group, and the Bois Blanc Formation from the vicinity of Ingersoll, Ontario, southward to Lake Erie. In all other areas of the peninsula he thought that the Delaware rested on the Detroit River Group. From Ingersoll southeast across the Niagara Peninsula, Best (1953, p. 193) believed that the upper member (his usage) of the Delaware overlapped onto the previously mentioned successively older formations.

In the vicinity of St. Mary's, Brussels, Goderich, and Amherstburg most modern workers agree that the Delaware Limestone is underlain by the Detroit River Group and that there is a disconformity separating the two units. This general agreement disappears when the isolated outcrops east of Port Dover are considered. Oliver (1967, p. A2) indicated that these rocks belonged in the Onondaga Formation, a conclusion different from that suggested by Best (1953).

After reinvestigation of the area from Ingersoll to Lake Erie including the Niagara Peninsula, Sanford (1967, pp. 983-985) included the sandy unit called Columbus by Best and other workers within the Lucas Formation of the Detroit River Group. He also included part of the Bois Blanc Formation of Best in the Amherstburg Formation, a unit stratigraphically above the Bois Blanc. Sanford suggested (1967, p. 981) that the Amherstburg Formation grades into the Edgecliff Member of the Onondaga Formation (Sanford, 1967, pp. 985-987).

The geologic map of the area compiled by Sanford (1969) does not follow his 1967 interpretation. The Delaware Limestone is mapped on top of the Lucas and Amherstburg Formations. Poole and others (1970, pp. 277-278) have followed the nomenclature used by Sanford in 1967. In the same volume, however, McLaren and others (1970, p. 617) suggested that in the Niagara to Woodstock area of Ontario the Detroit River Group is present and is an equivalent of the Onondaga Formation of New York. Furthermore, they use the formation name Delaware Limestone in place of the Dundee Formation used by Sanford.

It seems that the Delaware Limestone is underlain unconformably by upper Onondaga equivalents in the Niagara Peninsula and that the Delaware does not come in contact with the Bois Blanc Formation as Best suggested. The continued confusion in the literature together with the sparse and discontinuous nature of the outcrops in the area makes exact designation of the units beneath the Delaware there difficult at the present time.

Units Above the Delaware Limestone in Ontario

The Delaware Limestone in Ontario is directly overlain by the Hamilton Group. The Bell Shale, the lowest formation in the Hamilton, covers the Delaware Limestone in portions of Lambton, Middlesex, Elgin, and Kent counties according to Sanford (1967, p. 989). He also reported the Marcellus Formation directly overlying the Delaware near the Lake Erie shore in Elgin and southwestern Norfolk counties. The contact between the Delaware and the overlying Hamilton and Marcellus Formations is not exposed in southwestern Ontario. The break between these units is based on studies of cores, cuttings and drilling data.

The Base of The Delaware Limestone

Considerable disagreement has centered around the exact contact of the Detroit River Group and the Delaware Limestone (e.g., Best, 1953; Upitis, 1964; Ferrigno, 1968). There is certainly a demonstrable disconformity represented in all of the locations where the base of the Delaware Limestone is exposed. In this study the boundary was chosen on the basis of the first marked lithologic change seen at outcrops in the field. The length of time represented by the break between the two units is conjectural.

Marker Beds in Other Areas

Tioga Bentonite

The Tioga Bentonite, a key marker bed, has been recognized by Oliver and others (1967, p. 1019) at the top of the Columbus Limestone at surface locations near Sandusky, Ohio. They further reported it "...in both surface and subsurface sections from New York to eastern Tennessee and west to central Ohio". Collinson and others (1967, p. 954) noted that Meents and Swann had reported this formation in the Illinois Basin. Tioga Bentonite was also reported from the subsurface in Norfolk and Oxford counties, Ontario, and beneath Lake Erie by Sanford (1967, p. 987) between the Seneca and Moorehouse Members of the Onondaga Formation. At the present time this marker bed has not been recognized further north in southwestern Ontario.

Bone Beds

Wells (1944, pp. 278-283) described a series of four bone beds in Ohio, two of which occurred in the Columbus Limestone and two in the overlying Delaware Limestone. He stated that the second bone bed located at the top of the Columbus Limestone is the most consistent and is present from the vicinity of Columbus, Ohio northward to the exposures of the formation at Sandusky, Ohio.

The bone beds vary in lithology. According to Wells (1944) the second bone bed is a crinoidal limestone containing fish fragments (the bones), limestone pebbles, rounded and frosted quartz grains and a variety of heavy minerals. The others are either dolomitic sandstones and/or thin-bedded crinoidal limestones. All contain abundant fish fragments.

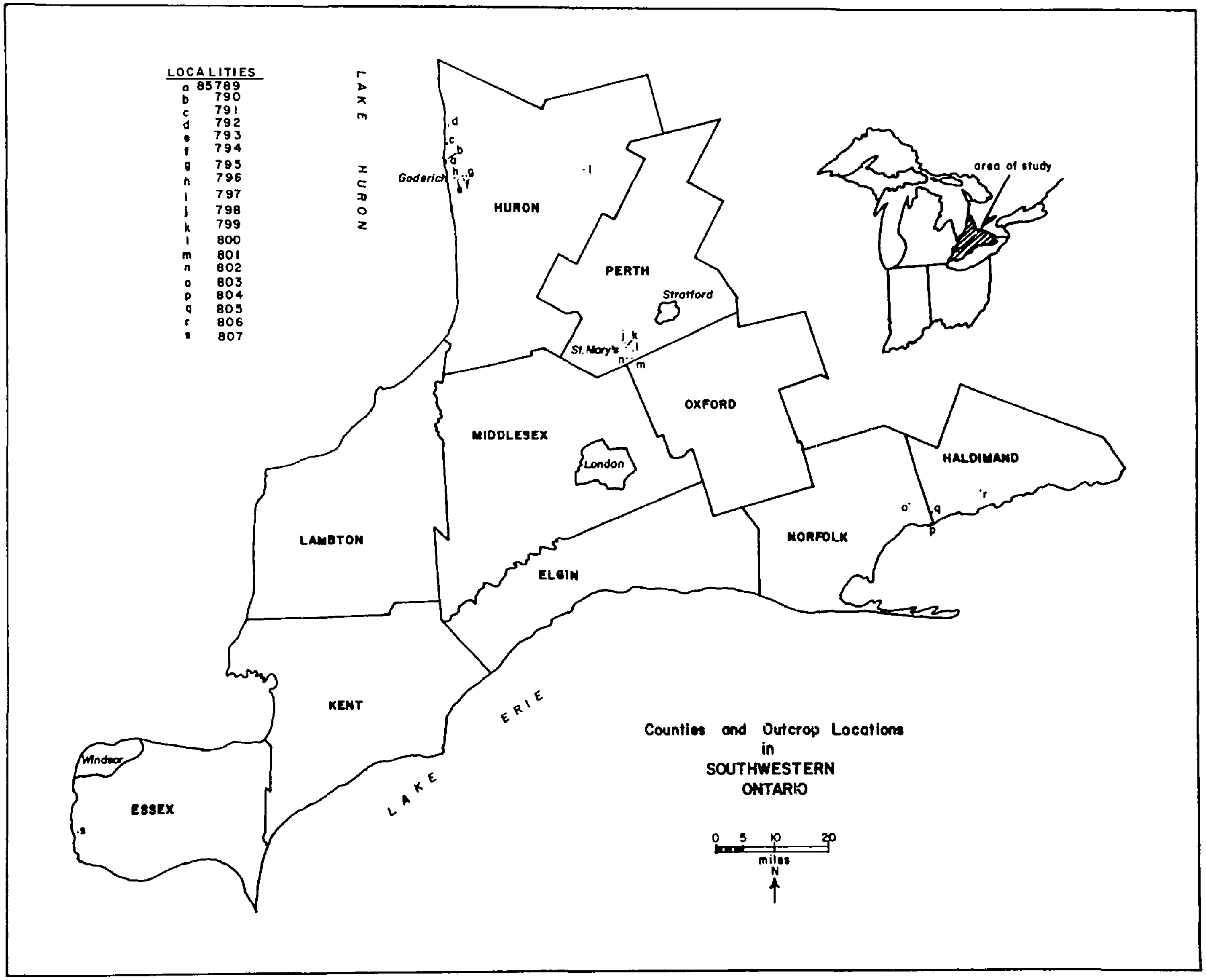
Large numbers of discrete fish fragments have been obtained from the Delaware Limestone in Ontario but no bone beds like those described by Wells have been found to date. The fish remains and their stratigraphic importance are discussed in later sections of this work.

Location of Outcrops

The most extensive outcrops of the Delaware Limestone occur along the valley sides of the Maitland River from the vicinity of Goderich, Ontario, upstream for several miles. Sections are variable in thickness and are discontinuous. The formation is overlain in this area by Pleistocene glacial deposits. To the east at Brussels a few small outcrops occur in and along the stream that passes through the town.

Other outcrops occur in the bed and occasionally along the sides of the Thames River from the south edge of St. Mary's, Perth county, upstream for several miles.

Text-Fig. 4. Map of counties and outcrop locations in southwestern Ontario. The first two digits of each locality number are 85.



Counties and Outcrop Locations in SOUTHWESTERN ONTARIO

Table 1

Register of Outcrop Locations

C.G.S. Cat. #	County	Township	Lot	Con.	General Location
85789	Huron	Colborne	6	BF	Point Farms Prov. Park at first stream south of the present bathing beach and boat landing at Wright Point
85790	Huron	Colborne	6	BF	Point Farms Prov. Park 100 feet north of stream (locality 85789)
85791	Huron	Colborne	11	BF	Bogies Beach 1.8 miles southeast of Sheppardton along a stream east of the beach
85792	Huron	Ashfield			300 feet west of the bridge over the Lucknow River at Port Albert; outcrops on south side of river
85793	Huron	Goderich	3	Maitland	Pipers Dam about 1.8 miles ESE of the center of Goderich on the south side of the Maitland River
85794	Huron	Goderich			East side of Reserve (formerly the Falls) along the south side of the Maitland River about .8 west of the bridge over the Maitland River at Benmiller
85795	Huron	Goderich			West of bridge at Benmiller along the north side of the Maitland River at Benmiller
85796	Huron	Goderich			Below old bridge, east of highway 21 at Goderich along the south side of the Maitland River about .7 mile northeast of the center of Goderich
85797	Huron	Grey			Beneath the highway bridge over the Middle Maitland River in Brussels

85798	Perth	Blanshard	25	River	Thames River at Motherwell along the west side just south of the river bridge
85799	Perth	Blanshard	7	16	Along the east side of the Thames River just south of the river bridge, 1.5 miles east of Science Hill
85800	Perth	Blanshard	16	13	Abandoned lime kiln .3 mile north of Highway 7; .7 mile west of the Thames River in St. Mary's
85801	Perth	Blanshard			St. Mary's Cement Co. Main Plant, at Lind Station
85802	Perth	Blanshard			St. Mary's Cement Co. New Quarry, about 1 mile northwest of locality 85801
85803	Norfolk	Woodhouse	17	3	1/2 mile south of Marburg along Black Creek 3 miles northwest of its mouth at Port Dover
85804	Norfolk	Woodhouse	24	1	Along the Lake Erie Shore approximately 2 miles southwest of Nanticoke
85805	Haldiman	Walpole	1	1	Abandoned Quarry about .8 mile north of locality 85804
85806	Haldiman	Walpole	18	2	Along Dry Creek at the Schweyer Farm .8 mile north of Cheapside
85807	Essex	Anderdon	7-8	1	Allied Chemical Brunner Mond Quarry about 2 miles north of Amherstburg at the Quarries Station

Exposures are sporadically present from Goderich north to Port Albert along Lake Huron and from Port Dover east to the vicinity of Selkirk along Lake Erie. Most of them are just a few feet in thickness and are often covered by shifting beach deposits (and in the case of those on the Lake Erie shore, fresh water algae). A few of the outcrops are located along small streams that enter the lakes.

Active quarries being worked in the formation are located at St. Mary's and at Amherstburg. At St. Mary's two quarries are active while three others are abandoned. Two of the latter three are almost completely filled with water.

The localities sampled are shown on the county map of southwestern Ontario (Text-figure 4). Table 1 is a register of these localities.

Thickness of the Delaware Limestone

The thickness of the Delaware Limestone at any outcrop or quarry in Ontario never exceeds 50 feet. In the subsurface it has been reported to be much thicker. Best (1953, p. 194) reported a probable total thickness of about 200 feet for the unit at the Fanshaw Dam near London, Ontario, based on a study of an unspecified number of cores taken by others earlier during preliminary sutdy of the site for construction of the dam. Unfortunately Best gave no description of the cores or of their fossil content and did not specify where they were stored. Sanford and Brady (1955, p. 7) studied well samples of the Delaware (= Dundee) and stated its range of thickness at from 80 to 160 feet in the Windsor-Sarnia area including Essex, Kent and Lambton counties. In 1957 Caley and Liberty (p. 226) suggested a maximum thickness for the Delaware of about 200 feet.

Probably the most comprehensive study of the subsurface thickness of the Delaware Limestone has been made by Sanford. His 1967 paper in part summarizes the work that he has done on this aspect of the unit over a number of years. He states that the Delaware (or Dundee in his terminology) thickens to a maximum of over 400 feet in the Michigan Basin, thins to less than 60 feet in northern Kent county in Ontario and thickens to around 150 feet in wells drilled in the floor of Lake Erie. Sanford's isopach map of the Delaware (figure 8a, p. 986) is particularly interesting because it indicates a thickness of less than 50 feet for the unit in the vicinity of Fanshaw Dam. If the cores that Best studied can be located in the future, a careful reevaluation of them should be undertaken in light of this apparent conflict in the thickness of the Delaware.

In August 1968 the writer visited the Canadian Geological Survey in Ottawa, Ontario, and discussed the problem of thickness of the Delaware with Dr. Bruce Sanford. At that time he stated (personal communication) that on the peninsula the unit thickens to over 100 feet in the subsurface and thins toward Essex county from the northeastern outcrop belt. He said that the contact between the Delaware Limestone and underlying Detroit River Group was relatively easy to determine from a study of cuttings because the lithology of the former is a crinoidal limestone while the latter is succrosic (sugar-like) in texture.

Appendix C is a compilation of observations made during a study of the cuttings from 42 wells across the peninsula. The data support Dr. Sanford's observations. Thicknesses range from less than 90 feet to about 160 feet near Lake Erie. Observations by Lamborn (1934, p. 347) on the Delaware Limestone in Ohio suggest that the formation ranges in thickness in outcrop from 30 to 70 feet. The unit tends to thicken to the east in the subsurface (Lamborn, 1934, p. 347). The list of well locations in Appendix C was obtained from Sanford (1964).

SEDIMENTARY PETROLOGY

Previous Work

Detailed measurements and descriptions of outcrops of the Delaware Limestone have been made by Stauffer (1915) and by Best (1953). Detailed petrographic study of the formation has been done previously at only one locality, the St. Mary's Cement Company Quarry (locality 85801) on the east side of the Thames River by Upitis (1964). Best (1953) did discuss some aspects of the petrography of the unit but did not illustrate variations or give a detailed account of them.

Upitis (1964) described five microfacies from the quarry on the basis of results obtained from study of both acetate peels and insoluble residues of the limestone. These microfacies in order upward through the section of Delaware Limestone are pelsparite, fine-grained biomicrite, biomicrite and coral biomicrudite, crinoidal biomicrudite and biomicrite and dismicrite. Upitis tied each of these microfacies to an environmental setting by comparison of the rocks and fossils with the environmental analyses of Elias (1937). Upitis suggested that his microfacies were indicative of gradually deepening water through time. Text- figure 5 relates his microfacies to those determined during this study.

Sampling Procedure and Sample Preparation

Lithologic samples were collected from the base of the Delaware Limestone or the exposure to the top of the outcrop at each of the nine-

Text-Figure 5

Comparison of Carbonate Microfacies Terminology
Applied to the Delaware Limestone

Upitis (1964)		This Paper
Microfacies 5	Fine-grained Biomicrite Dismicrite	Brachiopod Biomicrite Burrowed Biomicrite
Microfacies 4	Crinoidal Biomicrudite	Crinoidal Biomicrite
Microfacies 3	Coral Biomicrudite	Coral Biomicrite
	Biomicrite	Biomicrite
Microfacies 2	Fine-grained Biomicrite	
Microfacies 1	Pelsparite Pelletiferous Intrasparudite	Basal Quartzose

teen localities listed in Table 1 along the outcrop band from Lake Huron to Lake Erie. The samples were taken at one foot intervals, oriented with respect to the top of the sample and numbered from the base upward in sequence. Specimens were collected from positions between intervals at each major change in lithology.

A total of 254 samples were sawed vertically and polished. The polished faces were examined under a X30 binocular microscope and larger features such as skeletal debris, grain orientation, presence of metallic minerals etc., were noted. Thin-sections were prepared from each of the polished sections. These were examined microscopically to obtain an estimate of the overall composition of the rock. Four main components of the rock were estimated: matrix (i.e., fine-grained lime mud), cement (more coarsely crystalline calcite), grains, and pore space. Types of grains were determined as closely as possible using Majewske (1969) where the fossil type was not readily apparent.

Description of Microfacies

Most of the following microfacies (i.e., facies readily determined only by microscopic study of the rock) have been defined using the modified classification scheme of Folk (1962). Since this carbonate classification has been so widely used and described previously it is unnecessary to redescribe it here. Text—figure 6 shows the distribution of microfacies at all localities (the locality designations on this Text-figure include only the last three numerals). Appendix A includes descriptions of each lithologic sample.

Four primary microfacies are shown in Text-figure 6. Three of these four can be subdivided into more restricted microfacies types discussed below. The basal quartzose microfacies is classed as a single unit because of its unique nature. The recrystallized limestone and the biomicrite microfacies can be split into a number of types of microfacies on the basis of the most important grain constituent present in the rock (i.e., spores, brachiopods, etc.). The burrowed biomicrite and biomicrite microfacies can be split into micrite, burrowed biomicrite, and brachiopod biomicrite microfacies.

Basal Quartzose Microfacies

The base of the Delaware Limestone was observed in seven of the nineteen localities studied. The basal quartzose microfacies, characterized by the presence of well-rounded, frosted, quartz grains, lies directly above the contact at all seven localities. The thickness of this microfacies varies from one to three feet. At four localities (see Appendix A) the quartz grains are part of an intramicrite containing either angular or well-rounded intraclasts. At localities 85797, 85800 and 85807 the quartz grains are found in biomicrite. Plate 1 illustrates the varied rock types included in this microfacies. Quartz varies from coarse silt to sand-sized particles.

Recrystallized Limestone Microfacies (Plates 2 and 3)

In Huron county, the Delaware Limestone is primarily a partially recrystallized fossiliferous dolomitic limestone containing variable quantities of fossil grains and aggrading neomorphic dolomite rhombohedra set in an interlocking mosaic of calcite crystals. Fossil content of the microfacies varies from 10% to 65% and includes partly recrystallized calcitic bioclastic particles, phosphatic remains and carbonaceous spore exines.

Explanation of Plate 1

All figures are oriented perpendicular to bedding with top of bed toward top of figures. All thin sections are photographed in plain light.

Figure	
1	Basal quartzose microfacies. X1. Polished section of an unstained intramicrite slab. The dark layer near the base is the contact between the Detroit River Group (below) and the Delaware Limestone. Locality 85801. 0 feet above the base.
2	Basal quartzose microfacies. X8. Thin section of specimen shown in figure 1. Intramicrite consisting of large angular intraclasts, mud matrix and quartz silt and sand. A possible algal structure occurs at the base. Locality 85801.
3	Basal quartzose microfacies. X1. Polished section of unstained intramicrite with rounded intraclasts. Locality 85796. 0 feet above the base.
4	Burrowed biomicrite microfacies. X8. Thin section showing disruption of micrite and fossils by a burrowing organism. Locality 85801. 34 feet above the base.
5	Burrowed biomicrite microfacies. X1.5. Polished section of an unstained slab. Two types of burrows are present. The elongate burrow (A) near the top of the slab and the two circular burrows near the bottom (A) are distinct from the crescent-shaped burrow (B). Locality 85801. 34 feet above the base.
6	Crinoid biomicrite microfacies. X8. Thin section. The primary grain type is crinoidal. Locality 85801. 28 feet above the base.

7 Biomicrite microfacies. X8. Thin section. Grains included in the lime mud matrix are coral crinoid, brachiopod, and other skeletal debris. Locality 85801. 24 feet above the base.

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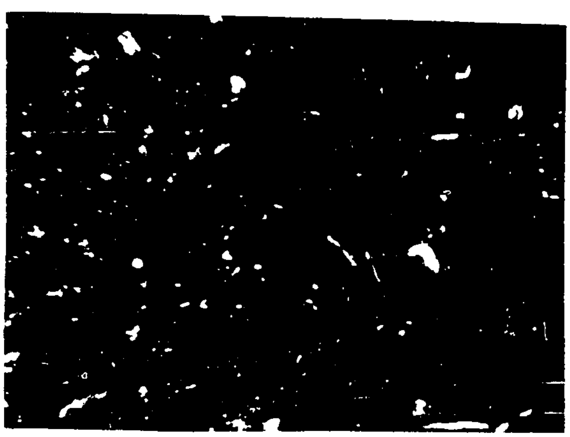

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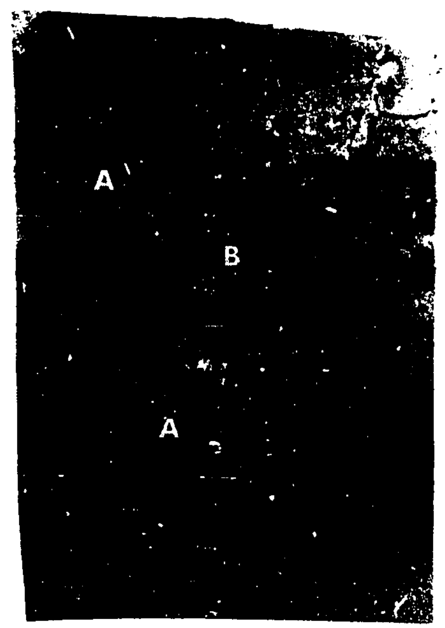

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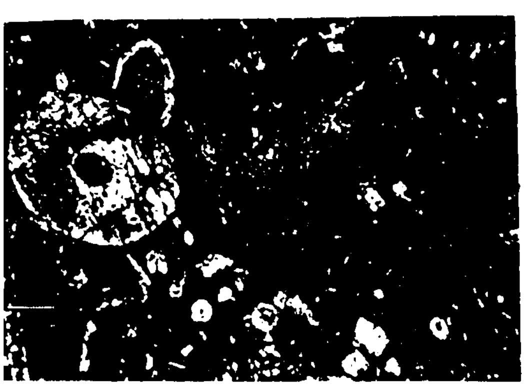

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Explanation of Plate 2

All specimens illustrated are thin sections in plain light, X8.

Figure	
1	Coral biomicrite microfacies. Large coral fragment surrounded by lime mud and skeletal debris. Locality 85801. 11 feet above the base.
2	Spore recrystallized limestone microfacies. Calcite spar with crushed black spores indicated by A. Locality 85793. 14 feet above the base.
3	Biomicrite microfacies. Fossils with calcite spar cement. Locality 85796. 4 feet above the base.
4	Crinoid recrystallized limestone microfacies. Crinoid ossicles surrounded by lime mud and calcite spar.
5	Biomicrite microfacies. Rounded spore exines present and outlined in black. Locality 85798. 1 foot above the base.
6	Micrite microfacies. Finely laminated micrite with stylolites present. Some calcite spar fills portions of stylolite. Locality 85796. 2 feet above the base.
7	Brachiopod biomicrite microfacies. Complete shells and single valves. Some whole shells are filled with a crystalline calcite mosaic. Shell orientation is either parallel to or perpendicular to bedding. Locality 85801. 38 feet above the base.

Explanation of Plate 3

All figures are oriented perpendicular to bedding with top of bed toward top of figure. Figures 1, 3, 5, 6 photographed in plain light.

Figure	
1	Dolomitic recrystallized limestone microfacies. X80. Dolomite rhombohedra surrounded by crystalline calcite. Locality 85793. 8 feet above the base. Rhombs labeled "r".
2	Dolomitic recrystallized limestone microfacies. X80. Locality 85794. 5 feet above the base
3	Biomicrite microfacies. X80. Fossil sponge with spicules and fossil grains. Locality 85806. 4.5 feet above the base.
4	Dolomitic recrystallized limestone microfacies. X80. Fossil grains with dolomite rhombohedra and crystalline calcite. Locality 85793. 13 feet above the base.
5	Dolomitic recrystallized limestone microfacies. X8. Crinoid ossicles and brachiopod valve surrounded by dolomite rhombohedra and crystalline calcite. Locality 85794. 7 feet above the base.
6	Same as Figure 5 but X80. Dolomite rhombs in center of crinoid ossicle.
7	Basal quartzose microfacies. X8. Sand grains and lime mud surround angular lime mud intraclasts. Locality 85793. 1 foot above the base.

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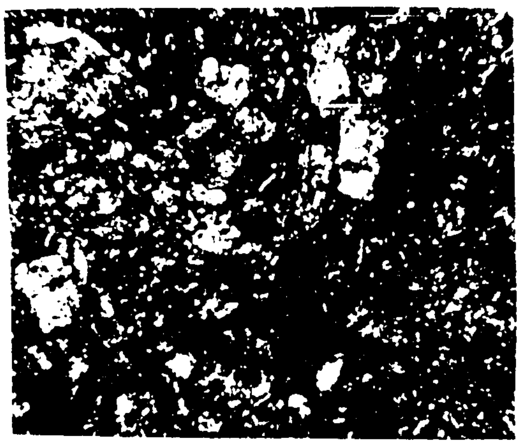

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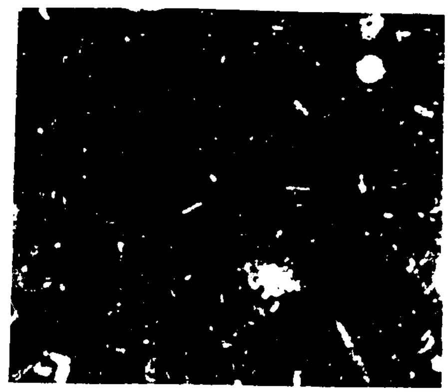

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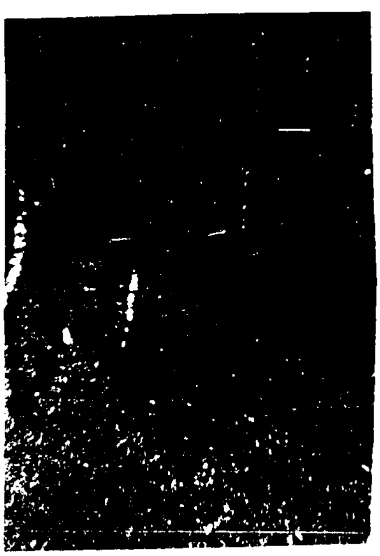

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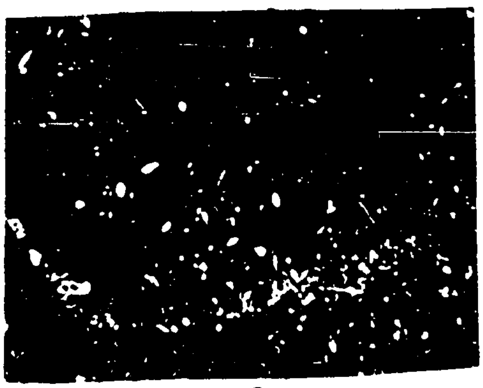

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Some samples of recrystallized limestone noted on Text-figure 6 have one predominent fossil type. In these cases the microfacies has been subdivided by adding the names crinoid, spore or coral to the microfacies name.

The microfacies has also been subdivided into dolomitic recrystallized limestone and a recrystallized limestone. The dolomitic recrystallized limestone occurs in the lower 15 feet of the formation in Huron county. X-ray analyses of rocks from this interval indicate concentrations of dolomite greater than 10%. From 15 to 28 feet above the base of the formation the microfacies contains less than 10% dolomite.

Crystalline calcite in the recrystallized limestone microfacies occurs as interlocking crystals .1 to .5 mm in diameter. These crystals can be mistaken for a more fine-grained matrix in thick thin-sections.

The recrystallized limestone microfacies is underlain by the basal quartzose microfacies and is overlain by the biomicrite microfacies in Huron county. It grades laterally to the southeast into a biomicrite.

Biomicrite Microfacies (Plates 1, 2)

This microfacies is extremely widespread and is represented at fifteen of the nineteen localities studied. It is highly variable in grain percentage and in the type of grains present. With the exception of locality 85797 at the extreme northeastern edge of the outcrop belt all of the localities in Huron county have the biomicrite microfacies represented minimally as interbeds in a predominately recrystallized rock suite.

In contrast to the low proportion of this microfacies in the north, the outcrops at St. Mary's in Perth county have a much greater thickness of biomicrite concentrated in the lower 30 feet of the Delaware Limestone.

The percentage of grains varies from a low of 10% to a high of about 70%. No general trends in grain increase or decrease could be determined from any of the sections studied.

In the vicinity of the Lake Erie shore in Norfolk and Haldimand counties the biomicrite microfacies is represented by relatively few interbeds containing low percentages of grains. Fossil grains generally vary from about 10% to slightly over 30% of the rock but fall primarily within the 10-25% range. This range is much lower than that observed in the St. Mary's area.

Crinoid biomicrite microfacies (Plate 1). This microfacies is represented in many of the sections studied. It is commonly interbedded with rocks of other microfacies in the biomicrite microfacies. This crinoidal microfacies is most common at the outcrops in Perth county and decreases in importance to the northwest (Lake Huron) and to the southeast.

It is characterized in all areas by a very high percentage of fossil grains. Crinoid ossicles usually make up 50-75% of the rock and 80-95% of the skeletal grains in any sample. This microfacies is best developed in the middle of the Delaware Limestone section exposed at St. Mary's (Localities 85801 and 85802). At locality 85801 it is the major microfacies from 20 to 35 feet above the base of the unit. At locality 85802 approximately one mile to the west across the Thames River two sequences of this microfacies occur. One is from 15 to 18 feet above the base of the unit while the other is from 27 to 35 feet above the base.

Coral biomicrite microfacies (Plate 2). In a number of strata in the St. Mary's area widespread thin, packed coral biomicrite layers occur.

These rocks were interpreted by Upitis (1964, p. 33) as organic bank accumulations. The accumulations are seldom more than one foot thick. Large numbers of unoriented fossils of many kinds are associated with the corals. Grains constitute up to 70% of the rock. Evidence of large scale abrasion and breakage is generally lacking. Although corals occur in some abundance in restricted horizons at other localities they are either not as abundant or not associated with as diverse a fauna as in the St. Mary's area.

Burrowed Biomicrite and Biomicrite Microfacies

Brachiopod biomicrite microfacies. Plate 1, figure 5 illustrates this distinctive lithology which occurs at the top of the quarry sections of the St. Mary's Cement Company (Localities 85801 and 85802) and at locality 85799 along the Thames River. The grains are primarily whole, articulated, small (1 cm long or less) brachiopod shells generally oriented with the shell thickness perpendicular to bedding. Almost all of the shells are filled, at least partially, with crystalline calcite. Where mud is present in the shells, crystalline calcite (spar) fills the upper portion of the shell cavity while mud fills the lower portion (geopetal structure). Bedding in this microfacies is much thinner than it is in the underlying microfacies and there are many more shaly partings. Argillaceous material is much more common throughout the rock. Evidence of burrowing is also present in some samples from this microfacies.

Burrowed biomicrite microfacies. This microfacies is also represented in the St. Mary's area in the upper portion of the Delaware Limestone exposed at localities 85799, 85801, and 85802. It is frequently interbedded with brachiopod biomicrite. Shell material in this microfacies is much smaller (often less than .1 cm) than in the brachiopod biomicrite microfacies and is almost entirely fragmental. It still constitutes a major portion of the rock fabric, however.

Bedding is thicker and the rock is generally more massive than in the brachiopod biomicrite microfacies. Burrowing of at least two types is present. Cylindrical burrows with crystalline calcite cores similar to burrow structures of some modern polychaete worms inhabiting carbonate environmental settings are common. Also present in some beds are burrow structures similar to those described by Seilacher (1964, p. 298). Plate 1, figures 4 and 5 illustrate these trace fossils.

Micrite microfacies (Plate 2, figure 6). At many localities a minor microfacies, the micrite microfacies, is present that is primarily solidified carbonate mud or micrite containing fewer than 10% allochems (fragmental carbonate debris). It is best developed in parts of the southern portion of the outcrop belt and decreases in importance toward the north. It is not a major component of the Delaware Limestone at any locality sampled.

Dolomite Analysis

Because dolomite was reported from the Delaware Limestone by Upitis (1964) some thin-sections were stained with Alizarin red-S using the techniques of Dickson (1965, p. 587) to determine the presence of dolomite. About half of the specimens stained entirely red - an indication of calcite according to Friedman (1959). Other thin sections were partially clear, a possible indication of the presence of dolomite. To test the hypothesis that dolomite was present in large quantity in some samples, 12 bulk samples, a number of which contained apparently high percentages of dolomite based on the lack of staining, were selected and prepared by crushing to a powder for X-ray analysis using a General Electric Model XRD-5 X-ray defractometer producing nickel-filtered copper radiation. Dr. S. B. Treves of the Department of Geology aided the writer in determination of the minerals present.

After determination of the minerals present the percentage of dolomite in each of the samples was obtained using the method of Tennant and Berger (1957). Dolomite was present in some of the samples but was highly variable in quantity from one sample to another ranging from less than 10% of the carbonate minerals present to more than 30%. Maximum percentages were obtained from samples from localities in Huron county. Dolomite generally decreases quantitatively both upward through the formation and laterally through the formation in a southeasterly direction. No more definite trends were established because of the small number of samples analyzed. Furthermore X-ray analysis indicated that the staining procedure for thin-sections did not work in all cases for undetermined reasons.

When dolomite occurs in the Delaware Limestone it is in the form of rhombs ranging in size from less than .1 mm to more than .4 mm in diameter. Liberty and Bolton (1971, p. 68) report that the rhombs are primarily restricted to the "matrix cement" of the rock although they do report rhomb replacement of fossil edges. During this study rhombs have also been observed in the centers of fossils such as crinoid columnals.

Insoluble Residues

Two sets of insoluble residues were obtained from each of the samples studied using procedures outlined in Appendix B. Insoluble products left after dissolution in dilute hydrochloric acid are described here. Acetic acid was used only to obtain microfossils for study. Insoluble materials from hydrochloric acid consist of rounded quartz sand grains, rounded quartz sand grains with quartz overgrowths, euhedral quartz crystals, chert, beekite (silica), pyrite, clay- and silt-sized particles (not studied for mineralogy), spores, scolecodonts, and rare trace minerals (undetermined).

Using the two quarries of the St. Mary's Cement Company as a model for study because of the fairly extensive exposures there, several trends can readily be discerned from study of the data in Appendix B. The amount of insoluble material fluctuates throughout the section but increases generally in the rocks of the uppermost portions of the quarries. Sand sized particles of quartz in the form of rounded, frosted grains, rounded grains with overgrowths and euhedral to subhedral crystals are common only in the basal few feet of the unit. Pyrite is most common near the base of the formation and toward the top but is rare in the middle portion of the formation. Spores are present throughout much of the unit but are least common in the central portion.

In general, the overall total insoluble material tends to decrease from St. Mary's northward and to stay at approximately equivalent amounts from St. Mary's southward.

Relationship of Insolubles to Microfacies

Quartz sand distribution tends to fall within the basal quartzose microfacies. This distribution pattern of sand has been noted by Summerson and Swann (1970, figure 2 and pp. 475 and 476) at the base of the Delaware Limestone in Ontario and Ohio as well as its equivalent the Dundee Limestone of Michigan, Ontario and Ohio. These authors link the presence of sand to overlaps by the sea depositing "...reworked sand concentrations at hiatuses" (1970, p. 486).

Largest quantities of clays and silts tended to fall within the brachiopod biomicrite and burrowed biomicrite microfacies with few exceptions.

Spores tend to occur in increased numbers in the recrystallized limestone microfacies in the northwestern part of the area and to decrease in quantity toward the southeast. They are rare at the outcrops near Lake Erie.

Chert (including beekite) seems to be irregularly distributed throughout the outcrop area, in single microfacies or in closely related microfacies.

PALEONTOLOGY

Previous Investigations

One of the earliest comprehensive investigations of the fauna of southwestern Ontario was carried on by Billings and reported on in a series of papers in 1860 and 1861. Some Ontario species were described by Hall in Palaeontology of New York (volumes 4-8). Nicholson (1874) also reported on aspects of the paleontology of Ontario.

In 1915, C. R. Stauffer listed in detail the fauna of the Delaware Limestone. Best (1953) revised the stratigraphy of Stauffer and included his own faunal lists.

More recently Winder (1967) discussed what is known of the microfauna of the peninsula. Ferrigno (1968) described the conodont fauna from locality 85801. Eller (1964) described the scolecodont fauna from four localities in Ontario and Ferrigno (1967) reported the occurrence of a holothurian sclerite from the Delaware Limestone. No large scale reinvestigation of the flora and fauna of the Delaware Limestone in Ontario apparently has been done until the present time.

Systematic Paleontology

The fossils listed in Table 2 were collected from either bulk samples or partially dissolved acetic acid residues from the Delaware Limestone at the locality designations listed. The fossils have been classified to the genus level using the classifications in the various published parts of the Treatise on Invertebrate Paleontology with the exception of the Porifera and Scolecondonts. Some genera from both of these groups are either not classified in the "Treatise" or have been recently reclassified in other publications. In these cases a more complete classification of the group is given.

Table 2 is a complete list of all the fossils identified during this study. It includes the distribution of each form as well as the number of specimens obtained at each locality.

Unless otherwise noted fossil specimens collected during this study are housed in the invertebrate and vertebrate paleontology collections of the University of Nebraska State Museum. They are designated in the text by the abbreviation UNSM in front of the specimen number. Fossils borrowed from the University of Western Ontario and the Canadian Geological Survey for study are noted by either the letters UWO or CGS in front of the specimen number.

PHYLUM PORIFERA

CLASS CALCAREA

ORDER OCTACTINELLIDA

FAMILY ASTRAEOSPONGIIDAE

GENUS *Astraeospongium* F. Roemer, 1848

Type species - *Blumenbachium meniscum* F. Roemer, 1848

Astraeospongium spp.

Pl. 4, figs. 1-3

Description - Calcareous spicules with six rays in same plane; rays narrow and needle-shaped or wide and flattened parallel to principal ray plane; some spicules with two other rays normal to principal plane and passing through central disk. Two rays normal to principal plane may vary in length compared to other six, which may be shorter, longer or of equal length.

Secondary ray sometimes present on each ray in principal plane; each secondary ray is normal to main ray and develops approximately midway between central disk and ray tip.

Ends of six main rays in three other specimens curved upward vertically. Smaller secondary rays may be directed downward from these.

Table 3 lists characteristics of each of the 72 spicules of *Astraeospongium* collected.

Remarks - Until 1968 most workers reporting *Astraeospongium* were satisfied with classifying it as a siliceous sponge (Lowenstam, 1948, p. 82; Richardson, 1950, p. 87) even though it proved to be extremely difficult to defend such a position. Rietschel (1968, p. 13-32) discussed the classification of all of the octactinellids. After a careful study of the spicules of these forms he concluded that *Astraeospongium* was a calcareous sponge rather than a siliceous one. His classification has been used in this study.

At least fourteen species of *Astraeospongium* have been reported from North America. Most of these have been defined on the basis of a few isolated spicules often obtained in partially or completely silicified form from limestones. Richardson (1950, p. 79-87) tabulated the characteristics of these various species and described one new species.

Astraeospongium was reported from the Delaware Limestone in Ontario by Stauffer (1915). A new species, *A. ohioensis*, was described by Wells (1943, pp. 210-211) from the top of the Columbus Limestone in Ohio. Ferrigno (1968) figured specimens from the Delaware Limestone at St. Mary's, Ontario, but did not describe them in detail.

In 1887 (pp. 91-97) Hinde classified *Astraeospongium* with the siliceous sponges and in 1888 he formally described the genus (pp. 133-134) indicating that Roemer had classified *Astraeospongium* as a Calcisponge. Hinde (1888, p. 133) believed that "the form and general character of the spicules of this genus, moreover, do not indicate any affinity with recognized Calcisponges, and I therefore regard the calcareous specimens as replacements after silica."

Because of the nature of the material from insoluble residues (i.e., discrete spicules of variable size and shape) no attempt was made in the present study to classify them below the genus level. From Table 3 it can be readily seen that there is an intergradation among the various forms collected. It is possible that they represent variations within a species. Some of them are probably microscleres. Further study of more material is needed before erection of new species is warranted.

Material and Occurrence - See Table 3.

Table 3

Characteristics of Astraeospongium

UNSM #	Slide #	Loc. #	Total Diameter (mm)	Vertical Rays
9539	A21	85801-1	1.25	broken
9540	A45	4	1.12	none
9540	A45	4	1.10	none
9540	A45	4	1.10	none
9541	A60	5	.80	none
9542	H34	28	.60	broken
9542	H49	28	.50	broken
9543	J58	85802-2	.70	none
9544	K5	3	.40	.75 (1 ray)
9544	K5	3	.80	broken
9545	K10	3.5	1.10	none
9545	K10	3.5	.80	none
9546	K24	5	.40	broken
9547	K30	8	.60	none
9548	K59	9	.65	broken
9548	L2	9	.55	.55 (1 ray)
9548	L4	9	.40	.35 (1 ray) rays also at tip of primary rays
9549	N55	22	1.35	broken
9549	03	22	.50	broken
9549	05	22	.95	broken
9550	Q12	27	.40	.55 (1 ray)
9551	Q30	31	.85	.50 (1 ray)
9552	T4	85790-1	2.40	broken
9552	T10	1	.70	broken
9552	T12	1	1.90	broken
9552	T16	1	1.00	none
9552	T23	2	.50	none
9552	T24	2	1.55	none
9552	T25	2	1.00	none
9553	V13	85800-0	.80	none
9554	V17	2	.50	none
9555	V21	3	.25	.25 (1 ray)
9556	V26	85797-0	1.55	none
9557	V3	85794-12	1.95	none
9558	V9	85793-13	1.25	none
9558	V10	13	2.15	none
9559	V26	21.5	1.50	none
9559	V28	21.5	1.00	none
9560	V29	22	1.10	none
9561	V35	27	1.40	none
9561	V36	27	1.45	none
9562	V38 (3)	28	.65	broken Secondary rays developed to horizon tap

9563	V52	30	1.25	none
9564	W10	85789-1	1.20	none
9564	W12	1	1.55	none
9565	W14	2	.75	none
9566	X40	85791-1	.85	.65 (1 ray)
9567	X55	5	1.35	none
9567	Y4	5	1.05	none
9568	Y9	6	.20	.20 (1 ray)
9569	Y18	7	1.50	broken hollow
9569	Y19	7	.35	none
9570	Y56	8	.60	none
9571	Z16	11	.50	none
9572	Z21	14	.30	broken Secondary v.r. at end of main vert. rays
9573	Z28	16	1.00	none
9573	Z30	16	.50	none
9574	Z33	15	.80	none
9575	Z39	18	.90	.50 (1 ray)
9575	Z41	18	.60	broken
9575	Z42	18	.50	.50 (1 ray)
9576	Z45	85792-6	1.50	none
9577	Z53	10	.45	.35 (1 ray) Horizontal ray tips curved
9577	Z55	10	1.31	none
9578	Z59	11	1.35	broken
9578	Z60	11	1.20	none
9579	AA8	85795-6	.70	none
9579	AA10	6	1.25	none
9580	AA18	7	1.65	.65 (1 ray)
9581	AA30	85806-8	.35	broken
9581	AA31	8	.85	broken
9582	AA35	9	.40	none

Note: Numbers to the right of locality numbers refer to the stratigraphic position in feet above the base of the section where the specimen was obtained.

Explanation of Plate 4

Figure

1-3 Astraeospongium spp., view down vertical axis of UNSM 9562, UNSM 9539, and UNSM 9571, X20.

4-7 Acinophyllum sp. cf. A. stramineum - 4, budding of corallites, UNSM 9315, X2; 5, 7, transverse and longitudinal section of one corallite, UNSM 9315, X8; 6, view of individual corallites in slab, UNSM 9315, X5.

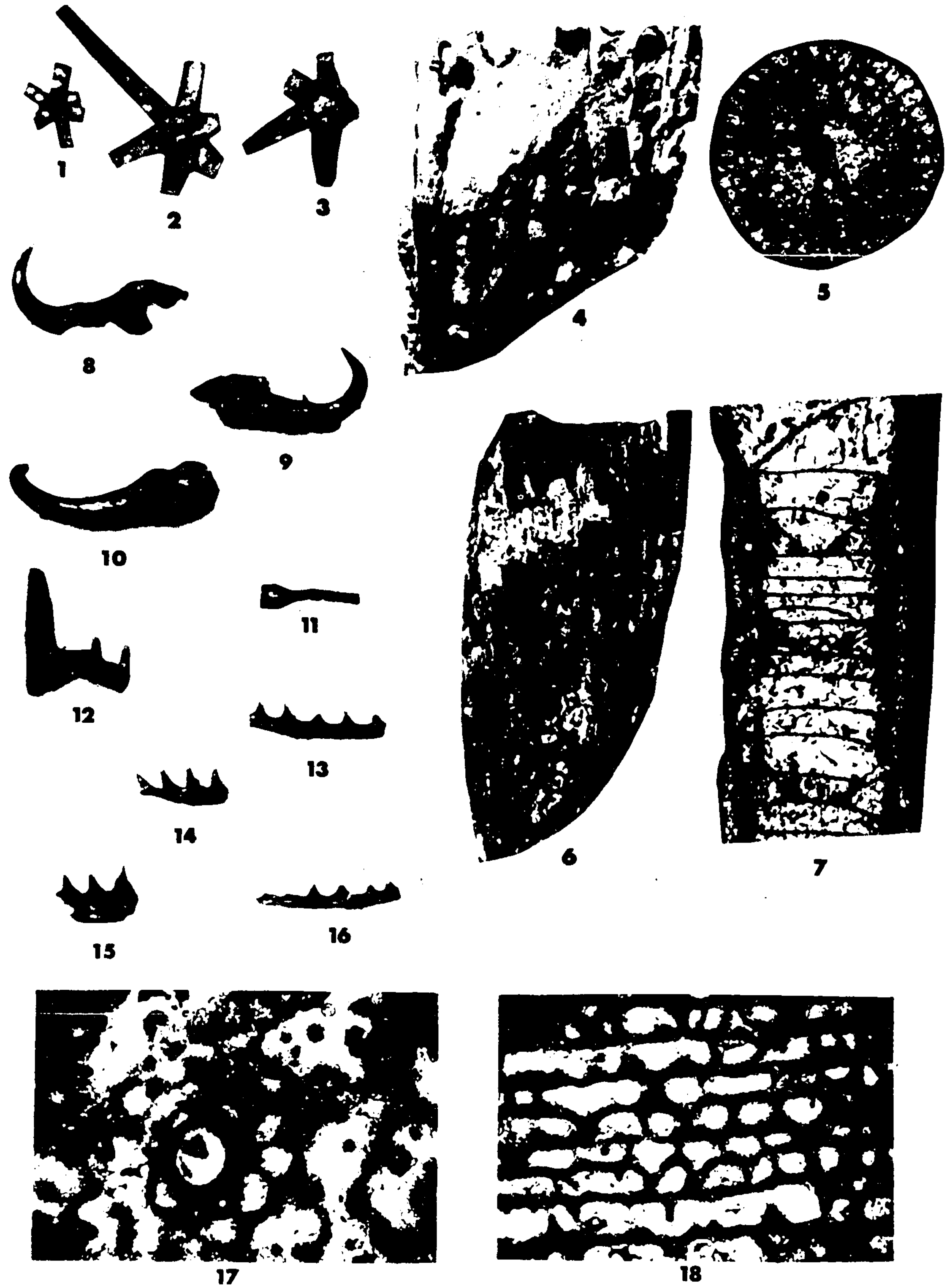
8-10 Drilonereisites apdus, n. sp. - 8, 9, lateral views of Paratypes UNSM 9015, X20; 10, lateral view of Holotype UNSM 9011, X20.

11 Siluropelta annae, n. sp. - lateral view of Holotype UNSM 9026, X20.

12 Neopriniodus sp. A - lateral view of UNSM 9130, X20.

13-16 Lonchodus sp. cf. L. dentatus Stauffer, lateral view of UNSM 9287A, UNSM 9287B, UNSM 9287C, and UNSM 9287D, X20.

17-18 Stromatoporella sp. - Transverse and longitudinal sections of UNSM 9293, X30.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PHYLUM COELENTERATA ?

SUBPHYLUM CNIDARIA ?

CLASS HYDROZOA ?

GENUS *Stromatoporella* NICHOLSON, 1886

Type species - *Stromatopora granulata* Nicholson, 1873, p. 94.

Stromatoporella sp.

Pl. 4, figs. 17, 18

Description - Coenosteum massive, diameter 12.5 cm; 4.4 cm thick; mammelons and astrorhizae absent. Laminae thin, single-layered, 6-8 in 2 mm, flattened or undulose and deflected to form ring-pillars with adjacent laminae; both ring and solid pillars straight, sometimes extending only part of way across gallery; width of solid pillars .05-.10 mm; galleries rectangular up to 2 mm long, .10-.50 mm high; dissepiments rare or absent; 6-7 pillars in 2 mm.

Solid pillars round , .10 to .25 mm in diameter, and .15 to .30 mm apart. Ring pillars round to c-shaped , .35 to .60 mm in diameter, and .35-4.0 mm apart. Solid pillars more than six times as abundant as ring pillars.

Remarks - This specimen resembles *Stromatoporella eriensis* (Park) as described by Galloway and St. Jean (1957, p. 165) but differs in having larger solid pillars, greater variation in spacing between ring pillars, and in having far fewer ring pillars than solid pillars.

Material and Occurrence - See Appendix D.

FAMILY PHILLIPSASTRAEIDAE ?

SUBFAMILY PHILLIPSASTRAEINAE ?

GENUS Acinophyllum MCLAREN

Type species - Eridophyllum simcoense Billings

Acinophyllum sp. cf. A. stramineum (Billings)

Pl. 4, figs. 4-7

A. stramineum, McLaren, 1959, pp. 22-23, pl. 9, figs. 3, 4, pl. 10, fig. 5; Text-fig. 8.

Description - Coralla cylindrical, with epitheca thin and showing numerous transverse ridges, phaceloid with connections only at bud; length of corallites 15 cm or more, width 3-6 mm. Corallites bud off side of calyx; after budding little or no connection maintained between corallites.

38 to 44 septa, uniformly thin. Variation in septal length between individuals extreme; some specimens with two orders of septa clearly defined, in other corallites orders of septa not clearly defined; length of longest septa 1.80 mm in 5.00 mm diameter corallite, shorter septa .65-.95 mm; some septa zig-zag with occasional well-developed zig-zag carinae present along entire septal length in some specimens.

Tabularium wide with tabulae spaced 7-8 in 5 mm, range between tabulae .4 to 1.25 mm., tabulae usually complete, horizontal to slightly convex upward. One row of dissepiments present.

Remarks - This species is questionably placed in the Family Phillipsastraeidae and the Subfamily Phillipsastraeinae because of the present confusion centering around these taxa.

Strusz (1965, p. 524) pointed out that although the family was based on the lack of horseshoe dissepiments in the type species, recent study of the type indicates that it does have these structures. Tsien (1968) reviewed the question of the family and concluded that the problem should be submitted to the International Commission on Zoological Nomenclature.

The genus name has also been revised a number of times. Smith (1945), for example, uses *Disphyllum* (*Synaptophyllum*) for the genus name of this species after the revision of the genus by Lang and Smith (1935 p. 546-547). Unfortunately, a characteristic of the genus *Disphyllum* (*Synaptophyllum*) is horseshoe dissepiments. *A. stramineum* does not have these structures according to McLaren (1959, p. 23).

There is confusion at the species level between the species *A. simcoense* and *A. stramineum* because of the fragmentary nature of the material originally described by Billings now classified as *A. stramineum*. McLaren (1959, p. 26) notes that the two species he defined may be nothing more than extremes of intergradion of a single species.

Material and Occurrence - See Appendix D.

PHYLUM BRACHIOPODA

CLASS ARTICULATA

GENUS *Brevispirifer* Cooper, 1942

Type species - *Spirifer gregarius* Clapp

Brevispirifer lucasensis (Stauffer)

Pl. 5, figs. 1 - 12; Pl. 6

Spirifer lucasensis Stauffer, 1909, pp. 522-523, pl. 23, figs. 1-5.

Brevispirifer lucasensis Cooper, 1944, p. 323, pl. 12, figs. 7-9.

Emended description to Stauffer (1909, pp. 522-523). - Pedicle valve interior with thickened floor laterally. Dental plates well-developed, medially concave, thick, and buttressing teeth and palintrope. Dental plates converge and thicken posteriorly to form a callus at posterior ends of delthrial and umbonal chambers. Teeth connected to inner margin of palintrope. No median septum.

Brachial valve interior with well-defined hinge plates; sockets located lateral to extreme inner margins of hinge plates. Incipient crural plates present, and joined to crural bases anteriorly; crus extend anteriorly from crural bases. No median septum.

Remarks - This species is characteristic of the Delaware Limestone in Ontario. It is widespread and occurs throughout the unit and in Ontario seems to be confined to the Delaware. It has also been reported by Stewart (1955, p. 172) from the Delaware Limestone of Ohio and the Dundee Limestone of Ohio and Michigan. Cooper and others (1942) reported the species from the Grand Tower Limestone.

Brevispirifer lucasensis (Stauffer) resembles *Mucrospirifer consobrinus* (d'Orbigny) that is also reported frequently from the Delaware Limestone. Both these species are characterized by having a well-developed costa in the sulcus of the pedicle valve and a furrow in the narrow fold of the brachial valve (Cooper, 1941, pp. 321 and 323). Study of Cooper's and Stauffer's descriptions of B. lucasensis and of Cooper's (1944, p. 321, Pl. 121) description of M. consobrinus, indicates that the characters of the two species may overlap.

The overlapping lengths, widths, surface features (number of costae, etc.) and internal structures suggest the possibility that these two species may be synonymous. Certainly the identification in numerous papers of either one species or the other but rarely both species from the same locality indicates possible misidentification. Stauffer (1909, p. 523) comments on the similarity of the two species but does not detail the differences between them. Stauffer's illustrations of the holotype do not fit the measurements he cites for it.

Scatter diagrams of B. lucasensis (see Text-figures 7-9) from Ontario indicate that while some specimens have nearly equal lengths and widths many are much wider than long. In terms of these measurements, however, no break can be determined between narrow forms and those that are more alate.

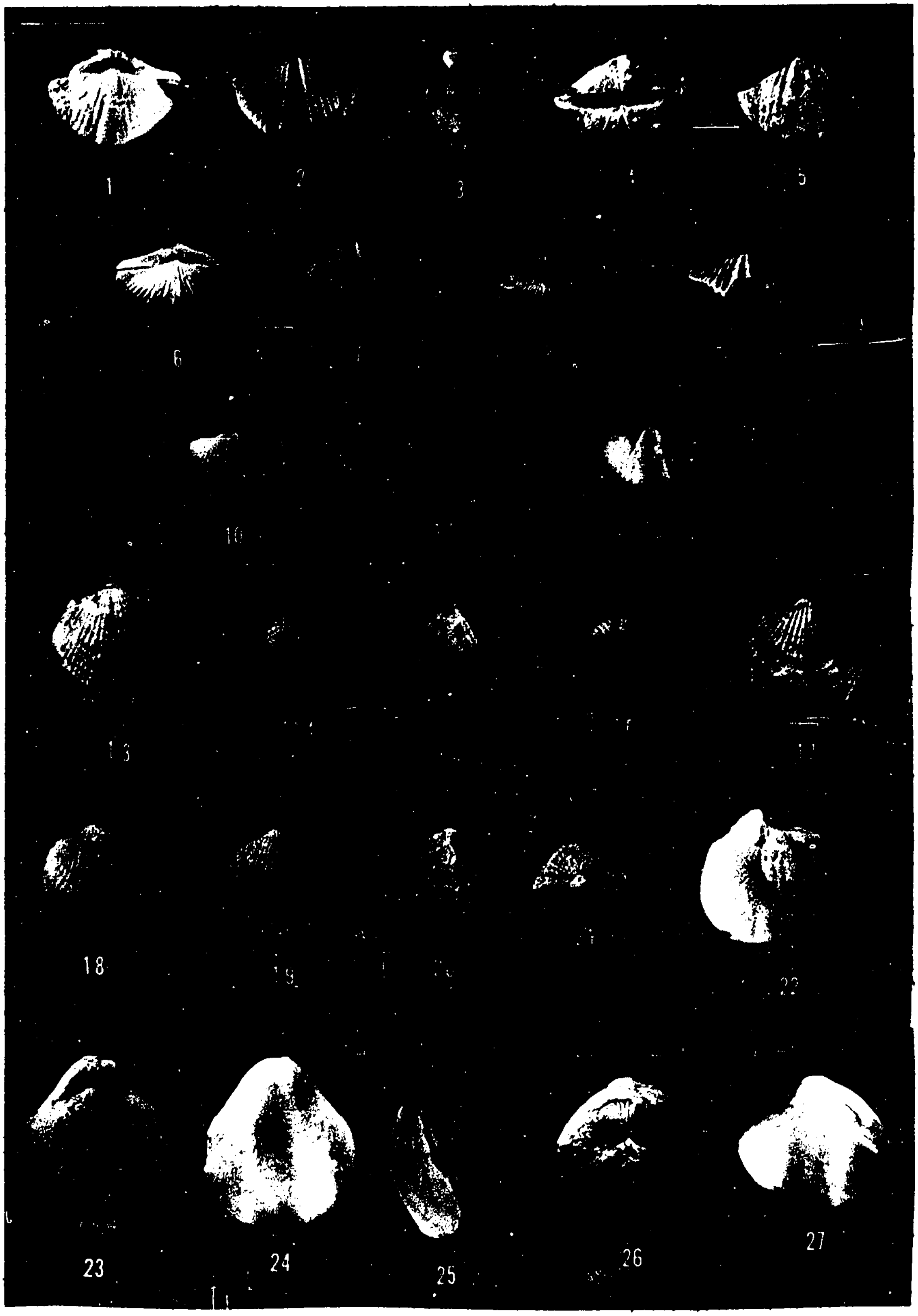
Both of these species need to be restudied to definitely determine whether they are either simply variants or are distinct species since the published accounts cannot be readily used to differentiate between them.

Material and Occurrence - See Appendix D.

Explanation of Plate 5

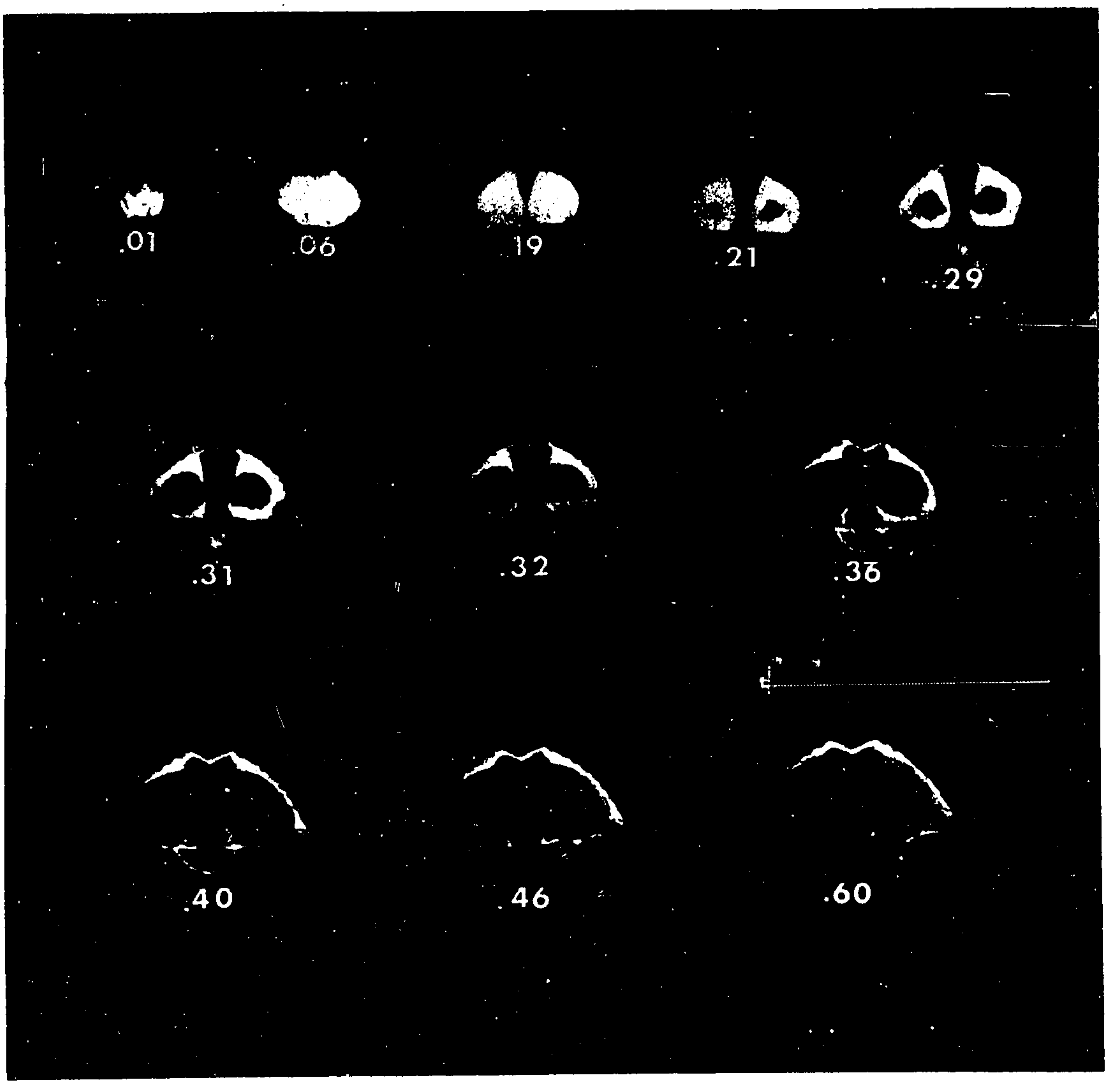
All specimens figured X1.

Figure	
1-12	Brevispirifer lucasensis (Stauffer). 1-5, dorsal, ventral, left lateral, posterior and, anterior views of UNSM 9482; 6-9, dorsal, ventral, posterior and anterior views of UNSM 9483; 10-12, dorsal, posterior and ventral views of steinkern UNSM 9491.
13-21	Spinatrypa spinosa (Hall. 13-17, dorsal, anterior, left lateral, posterior and ventral views of UNSM 9435; 18-21, dorsal, ventral, left lateral and posterior views of UNSM 9436.
22-27	Martiniopsis? maia (Billings). 22, ventral view of steinkern UWO 970 showing impressed muscle field; 23-27, dorsal, ventral, left lateral, posterior and anterior views of UWO 970.

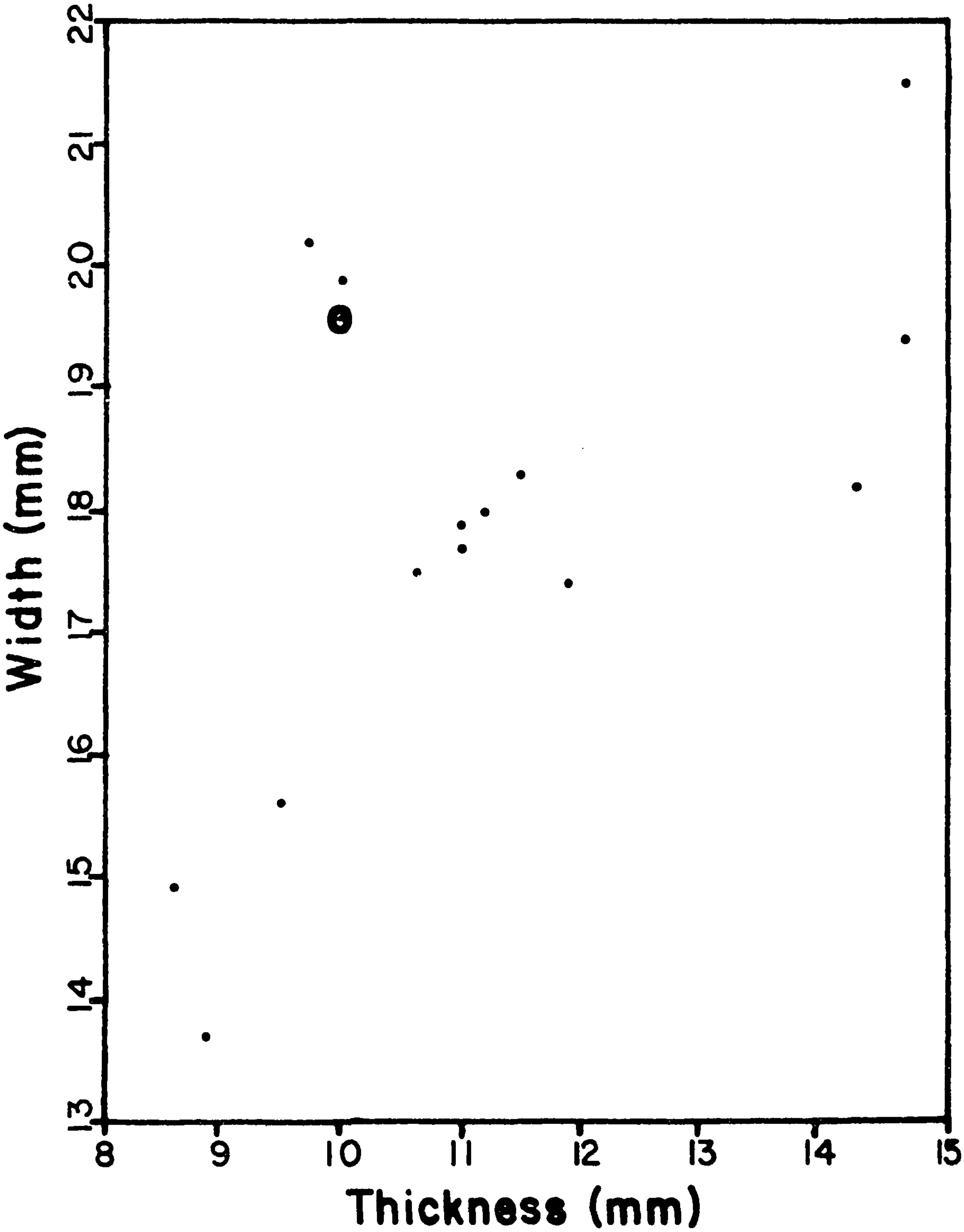

1
6
10
18
23
24
25
26
27

Explanation of Plate 6

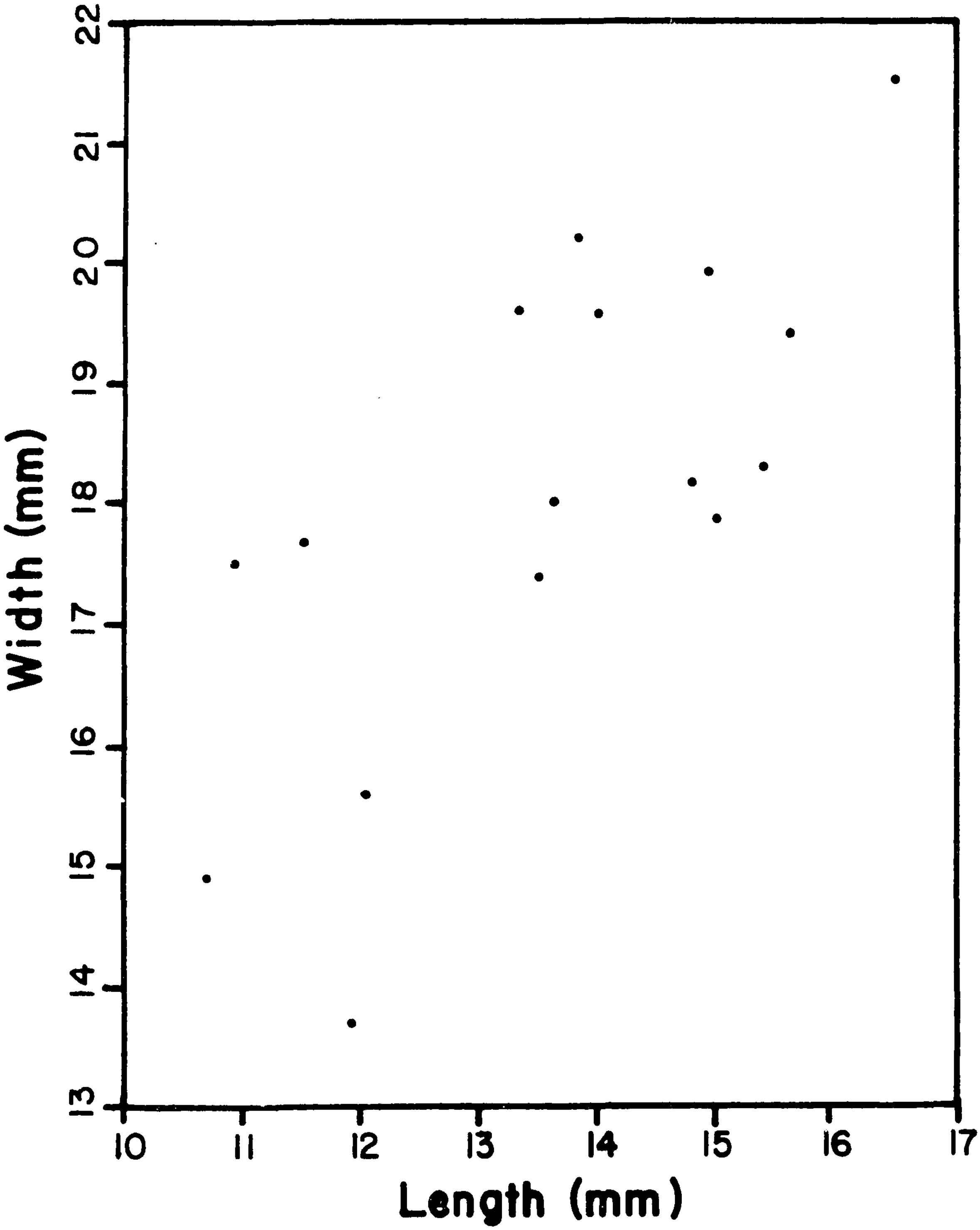
Serial sections of *Brevispirifer lucasensis* (Stauffer) from locality 85801, 19 feet above the base of the unit (UNSM 9491). Measurements in centimeters anterior of tip of beak. Pedicle valve on top. All sections X 1.5 diameters.


.01
.06
.19
.21
.29
.31
.32
.36
.40
.46
.60

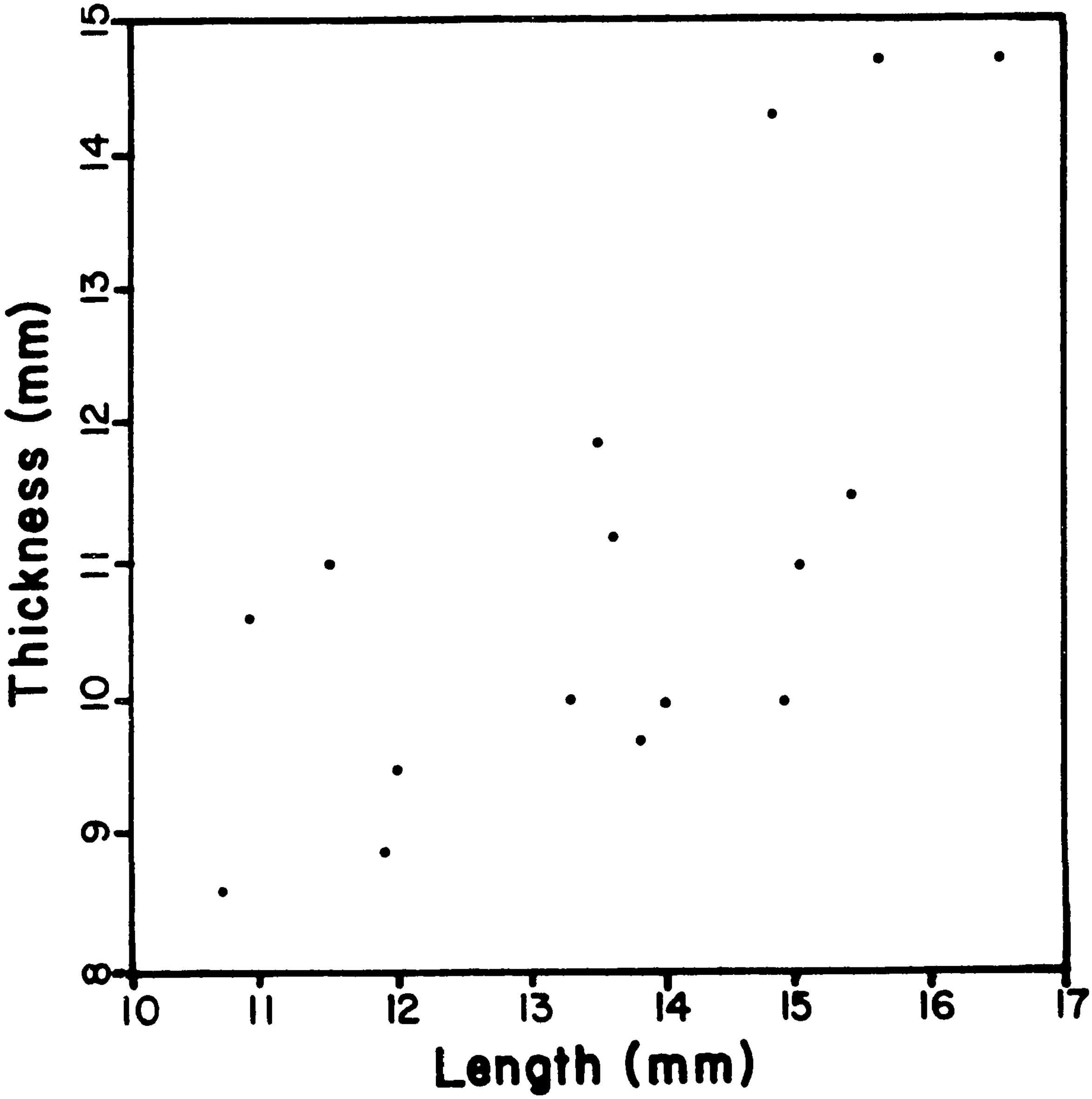
Text-fig. 7. Scatter diagram of thickness against width of *Brevispirifer lucasensis* (Stauffer) collected from the Delaware Limestone. The larger circle indicates two measurements.


Width (mm)
13
14
15
16
17
18
19
20
21
22
Thickness (mm)
8
9
10
11
12
13
14
15

Text-fig. 8. Scatter diagram of length of pedicle valve against width of *Brevispirifer lucasensis* (Stauffer) collected from the Delaware Limestone in Ontario.


Width (mm)
22
21
20
19
18
17
16
15
14
13
10
11
12
13
14
15
16
17
Length (mm)

Text-fig. 9. Scatter diagram of thickness against length of pedicle valve of *Brevispirifer lucasensis* (Stauffer) collected from the Delaware Limestone in Ontario.



Thickness (mm)
15
14
13
12
11
10
9
8
10
11
12
13
14
15
16
17
Length (mm)

GENUS *Spinatrypa* Stainbrook, 1951

Type species - *Atrypa aspera* var. *occidentalis* Hall, 1858.

Spinatrypa spinosa (Hall)

Pl. 5, figs. 13-21; pl. 7

Atrypa spinosa Hall, 1857, pl. 53A, figs. 1-14, 18, 24, 25.

Remarks - Hall (1857, pp. 322-325) was uncertain whether his *Atrypa spinosa* was a distinct species or was the same as the European species *Atrypa aspera*. The latter species has been placed in the genus *Spinatrypa* by Copper (1967b) who redescribed the genus *Spinatrypa* and the species *Spinatrypa aspera*. Comparison of Copper's description and serial sections of *S. aspera* with specimens of *S. Spinosa* collected from the Delaware of Ontario by the present author supports Hall's separation of these two forms. Maximum lengths, widths, and thicknesses of *S. spinosa* are greater than those of the European species. There are about twice as many ribs and growth lines in *S. spinosa*. Text-figures 10, 11 indicate variation in measurements of this species.

Internally the structures of *S. spinosa* are similar to *S. aspera* as well as to other species described by Copper (1967b) but differ significantly from all of these in a number of ways. Using the terminology outlined by Copper (1967a, pp. 1176-1183) for common atrypid internal structures as a basis for comparison of his figures and photographs with *S. spinosa* from Ontario, the most striking difference is in the length of the crural bases. *S. spinosa* has extremely long delicate crural bases that extend upward toward the pedicle valve and almost come in contact with it. The median septum is much smaller in *S. spinosa* than in other forms similar to it.

Copper (1976b, p. 494) suggests that larger species of Spinatrypa in Europe occur in younger rocks. These forms have progressively fewer growth lines and ribs and have an increase in the spinose nature of the valve.

Bassett (1935, p. 45) described a new species, Atrypa costata from Dundee Limestone of Michigan and Amherstburg, Ontario. He commented that this form was probably that identified by earlier workers as Atrypa spinosa from these areas. Bassett even remarked upon the similarity of the two species. Unfortunately he did not publish a description of the interior of the species. A later examination of this critical species is planned to determine its exact taxonomic position.

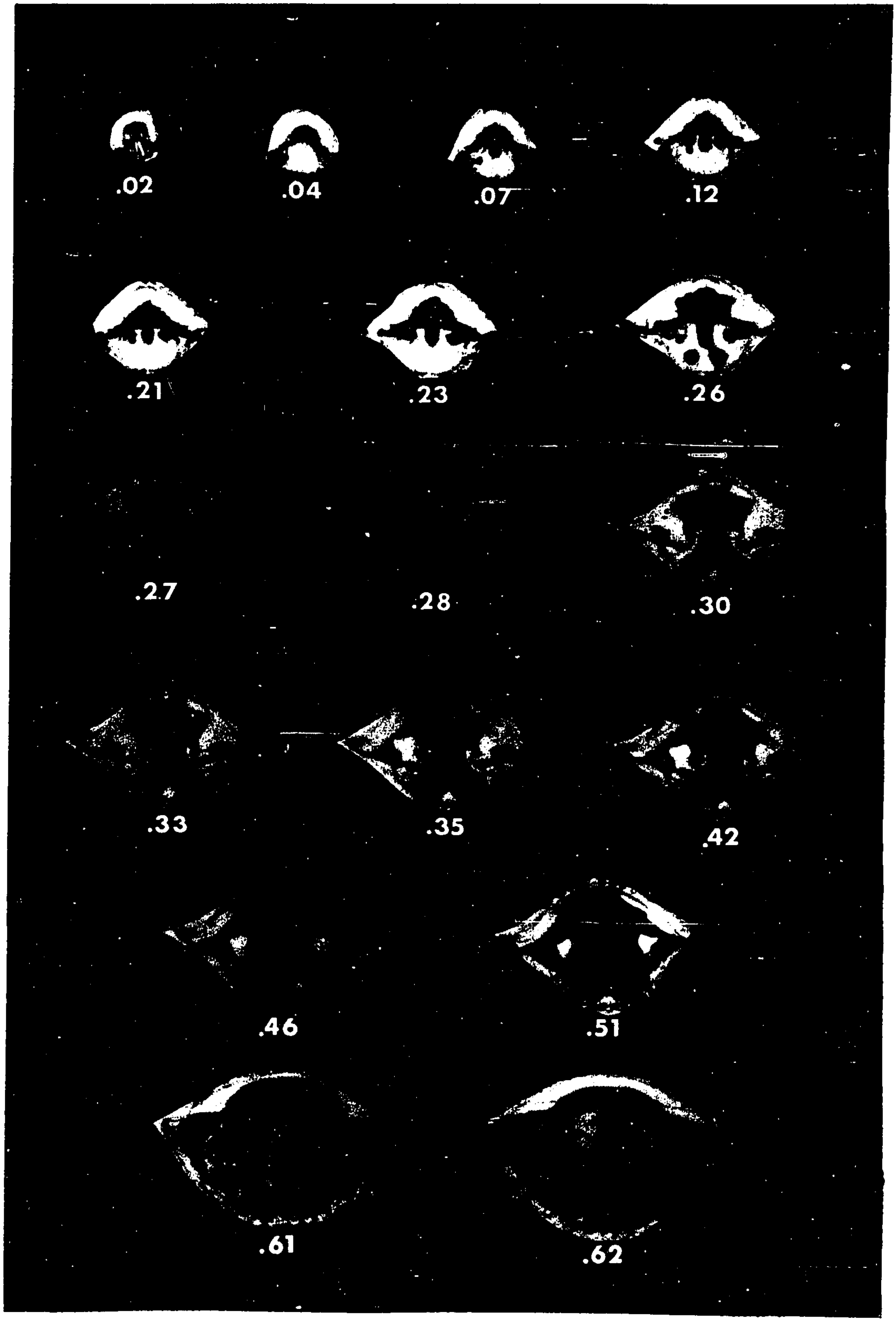
Stewart (1955, p. 171) also considered A. costata a probable equivalent of A. spinosa but left this suggestion open for further study. She listed these forms together as A. costata and used this form as one of the few key species for correlation of the Dundee Limestone in Michigan and Ohio with the Delaware Limestone of central Ohio and Ontario (1955, p. 179). Furthermore, she listed A. costata in the Columbus Limestone as well (1955, p. 163).

To add to the confusion centering around this species (or several species) is the report by Chadwick (1935, p. 317-325) of the occurrence of Atrypa spinosa in the upper Devonian Naples, Chemung and Canadaway Groups of New York, Pennsylvania and Ohio. If this identification is correct this species is certainly of little use as an index for Middle Devonian units.

Material and Occurence - See Appendix D.

Explanation of Plate 7

Serial sections of *Spinatrypa spinosa* (Hall) from locality 85801, two feet above the base of the unit (UNSM 9444). Measurements in centimeters anterior of tip of beak. Pedicle valve on top. All sections X2 diameters.


.02
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.42
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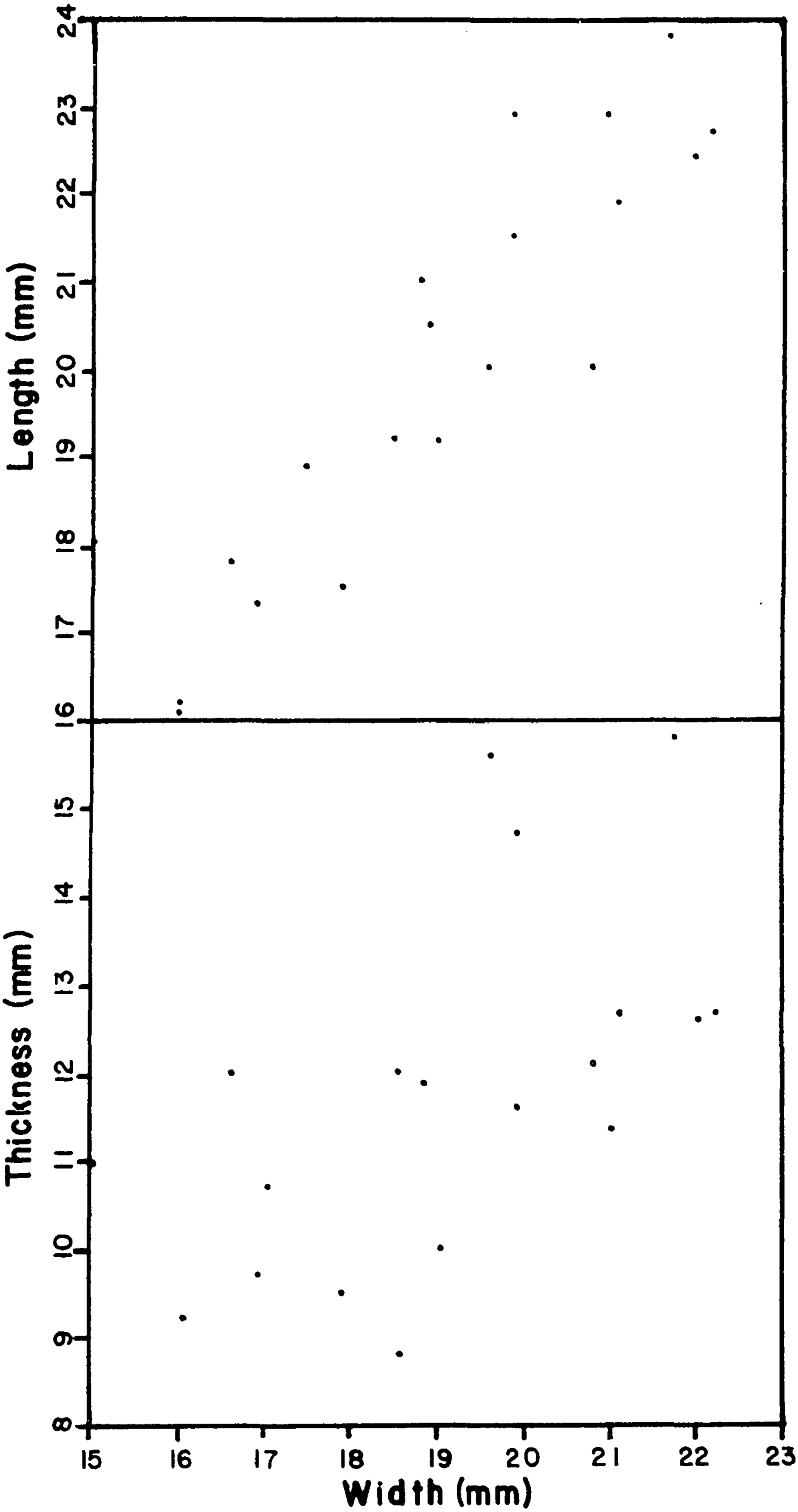
.51
.61
.62

Text-Fig 10. Scatter diagrams of (1) length of pedicle valve, and (2) thickness against width of Spinatrypa spinosa (Hall) collected from the Delaware Limestone of Ontario.



Length (mm)
Thickness (mm)
Width (mm)
24
23
22
21
20
19
18
17
16
15
14
13
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11
10
9
8
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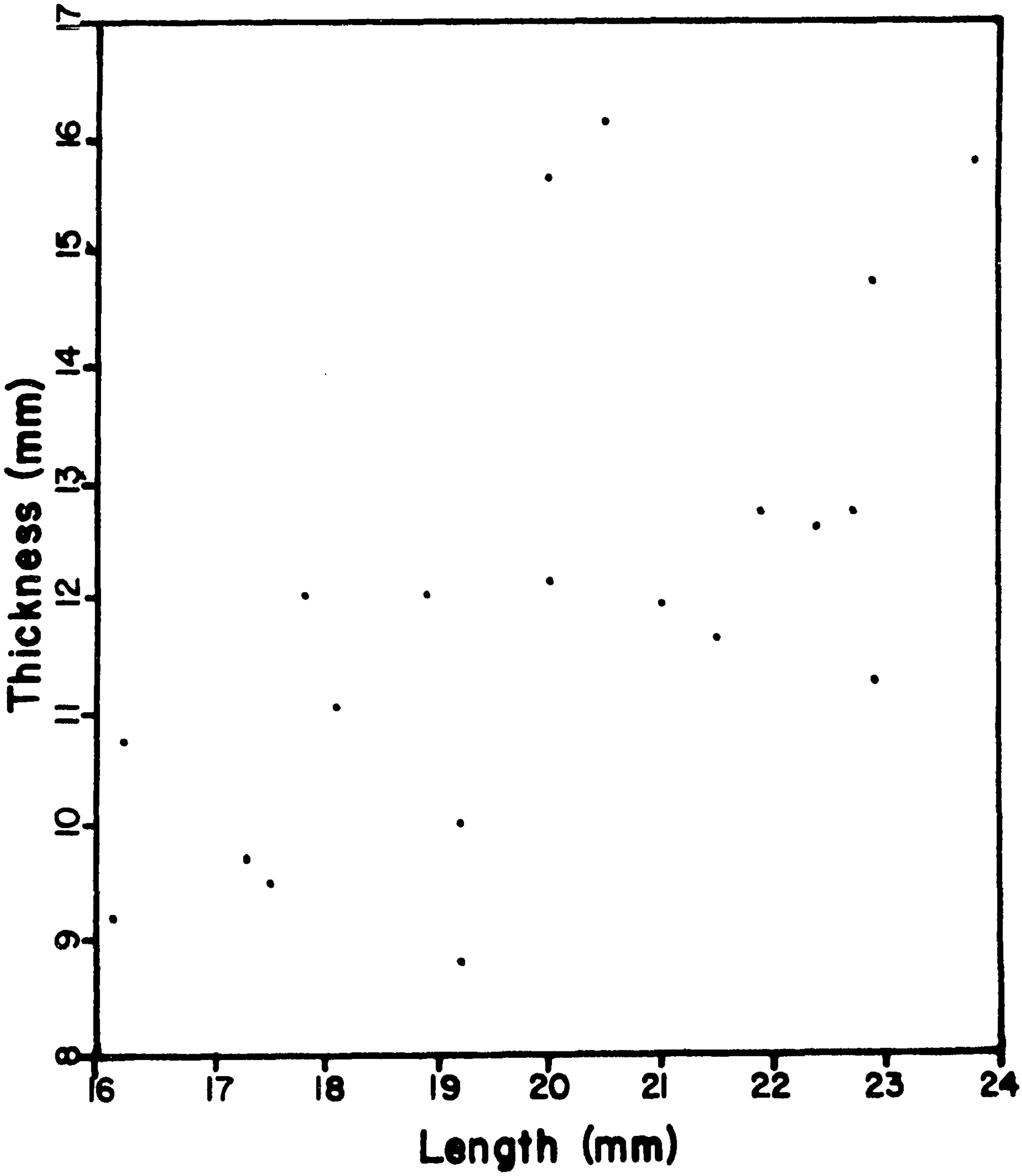
Text-Fig 11. Scatter diagram of length of pedicle valve against thickness of Spinatrypa spinosa (Hall) collected from the Delaware Limestone of Ontario.



Thickness (mm)
8
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12
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14
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17
18
19
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21
22
23
24
Length (mm)

SUPERFAMILY Reticulariaceae

GENUS *Martiniopsis* Waagen, 1883

Type species - *M. inflata* Etheridge, 1892

Martiniopsis ? *maia* (Billings)

Pl. 5, figs. 22-27; pl. 8

Athyris maia Billings, 1860, p. 276, figs. 33, 34.

Spirifera maia Hall, 1867, p. 416, pl. 63, figs. 6-13.

Athyris (?) *maia* Nicholson, 1874, p. 88.

Spirifera (M.) *maia* Walcott, 1884, p. 141, pl. 3, figs. 1, 1a-e; pl. 14, figs. 13, 12a.

Martinia maia Schuchert, 1897, p. 263.

"Martiniopsis" maia Cooper, 1944, p. 329, pl. 126, figs. 34, 35.

Description - Shell biconvex; cardinal margin short, rounded with small ventral palintrope. Dorsal outline subcircular in smaller forms becoming more elongate in larger specimens; anterior margin straight. Pedicle valve about 50% deeper and more convex than brachial valve. Umbones convex. Beak of pedicle valve erect to slightly incurved and protruding slightly over beak of brachial valve. Pedicle interarea concave. Anterior commissure sharply uniplicate; ornamentation consisting of capillae and closely spaced, low growth lines except near anterior margin where growth lines become more prominent. Shell structure impunctate.

Pedicle valve length about equal to width (see Text-figs. 12-14); position of greatest width at about 2/3 valve length. Apical angle approximately 75°. Delthyrium open; foramen hypothyridid. Sulcus about 1/3 width of valve, extending from umbo to anterior margin; sulcus weakly developed, very shallow, and slightly rounded.

Pedicle valve interior with extremely thickened floor and well-developed parallel and anteriorly directed dental plates buttressing teeth and palintrope. Dental plates joined posteriorly, thickened, and closely spaced. Delthyrial chamber slit-like. No median septum. Muscle field deeply impressed, oval, but poorly differentiated.

Brachial valve wider than long, greatest width at about 1/2 of valve length; fold approximately 1/4 of valve width, well-developed, evenly rounded and extending from umbo to anterior margin. Brachial valve interior with well-developed hinge plates; sockets located at extreme interior margins of hinge plates. Anteromedially directed, longitudinally striated cardinal process fills space between hinge plates at posterior end of valve, becoming separated from hinge plates anteriorly; crural bases attached to hinge plates below interior margins of hinge plates and extending anteriorly beyond hinge plates becoming distinct crural. Spiralia spiriferoid with a maximum of eight loops on either side of median plane. Jugum absent.

Remarks - Most recent workers have reported this species as belonging to either the genus Martinia or to the genus Martiniopsis. The former genus has no dental or crural plates while the latter genus has crural plates (see Treatise on Invertebrate Paleontology, Part H, p. H726). Brachiopods from St. Mary's Ontario, do not fit either of these two diagnoses and probably belong to an entirely different genus. Since a revision of the genus *Martiniopsis* is beyond the scope of this work the present species is questionably assigned to *Martiniopsis* because it resembles that genus most closely.

Martiniopsis ? *maia* (Billings) is a widely used index fossil for correlating the Delaware Limestone of Ohio with rocks of equivalent age across North America. It has been reported as occurring not only in Ohio, and Ontario but also as far west as Nevada. Walcott (1884, pp. 141-142), for example, described this species from Devonian rocks of the Eureka District of Nevada. Merriam (1940) reported findings of this species by Walcott and other workers but questioned the presence of *Martiniopsis maia* in Nevada. He suggested (1940, p. 85) that Walcott's specimens lacked the external shell features necessary for identification. Nonetheless, Cooper and others (1942, p. 1773) correlated the lower part of the upper Nevada Limestone with the Delaware Limestone of Ohio because of the "...brachiopods strongly suggestive of "*M*". *maia* (Billings)..." within the former rock unit.

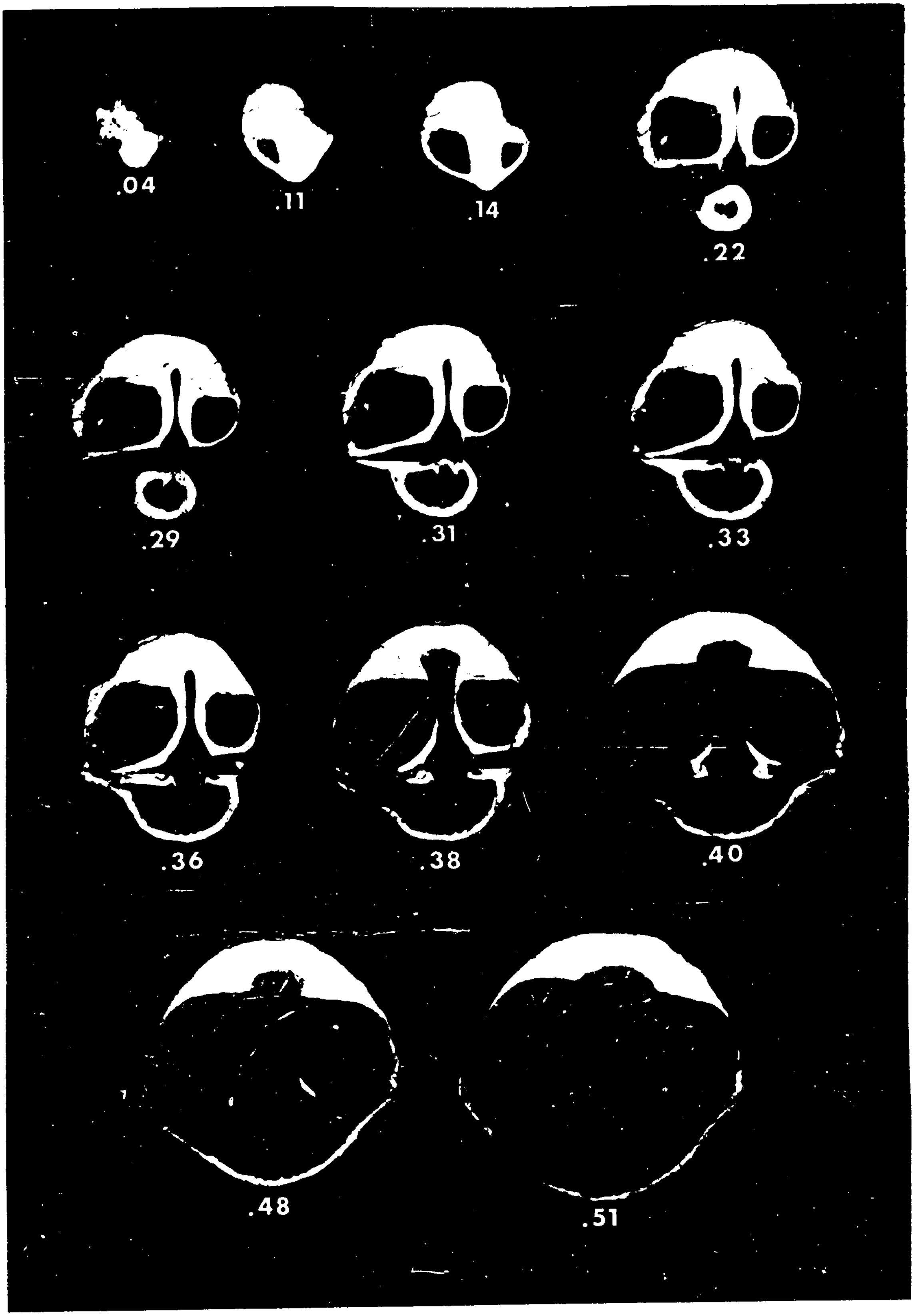
The holotype and the original syntypic suite collected by Billings apparently have been lost from the collections of the Canadian Geological Survey. The present redescription is based on a very small sample of five specimens collected during this study, six topotypes borrowed from the collections at the University of Western Ontario in London, Ontario, and seven specimens borrowed from the Geological Survey of Canada. A larger collection of this species will be made from the rocks of the type locality at St. Mary's Ontario, in the future so that a more detailed study of this important species can be undertaken.

This species has been previously reported in St. Mary's from the uppermost portion of the quarry section at the St. Mary's Cement Company by both Stauffer (1915) and Best (1953). One specimen was collected by the present author from within two feet of the base of the Delaware, extending the local range zone of this species in Ontario.

Material and occurrence - Specimens UNSM 9500 and 9501a-e from locality 85801 at 2 and 40 feet above the base of the Delaware Limestone.
6 specimens labeled UWO 970 and 7 specimens labeled GSC 4404.

Explanation of Plate 8

Serial sections of Martiniopsis ? maia (Billings). Specimen sectioned (UWO #970 topotype) by permission of University of Western Ontario. Measurements in centimeters anterior of tip of beak. Pedicle valve on top. All sections X2 diameters.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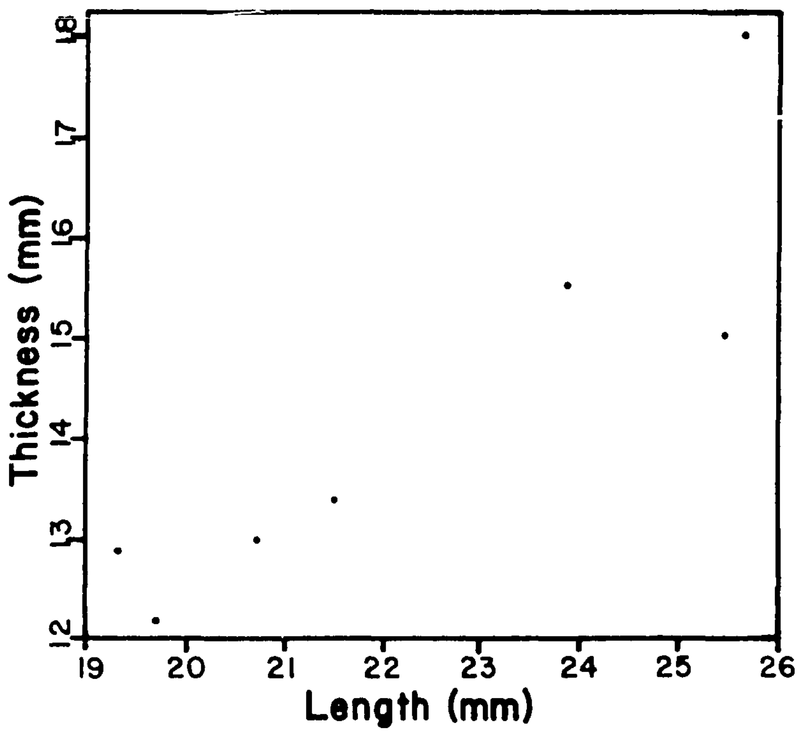
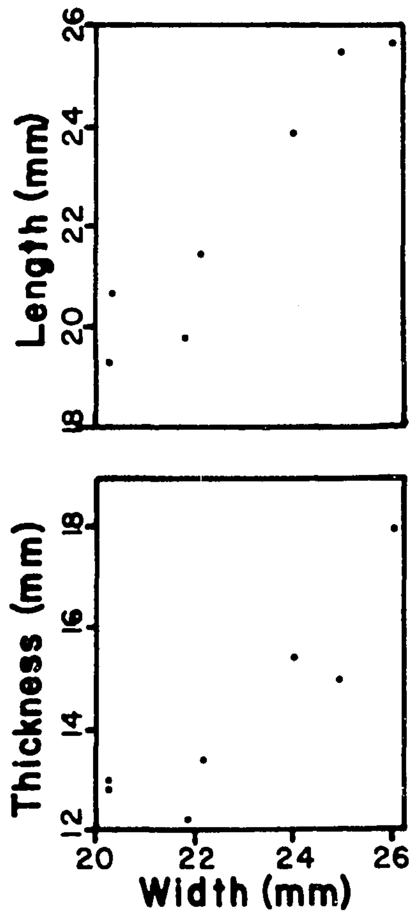
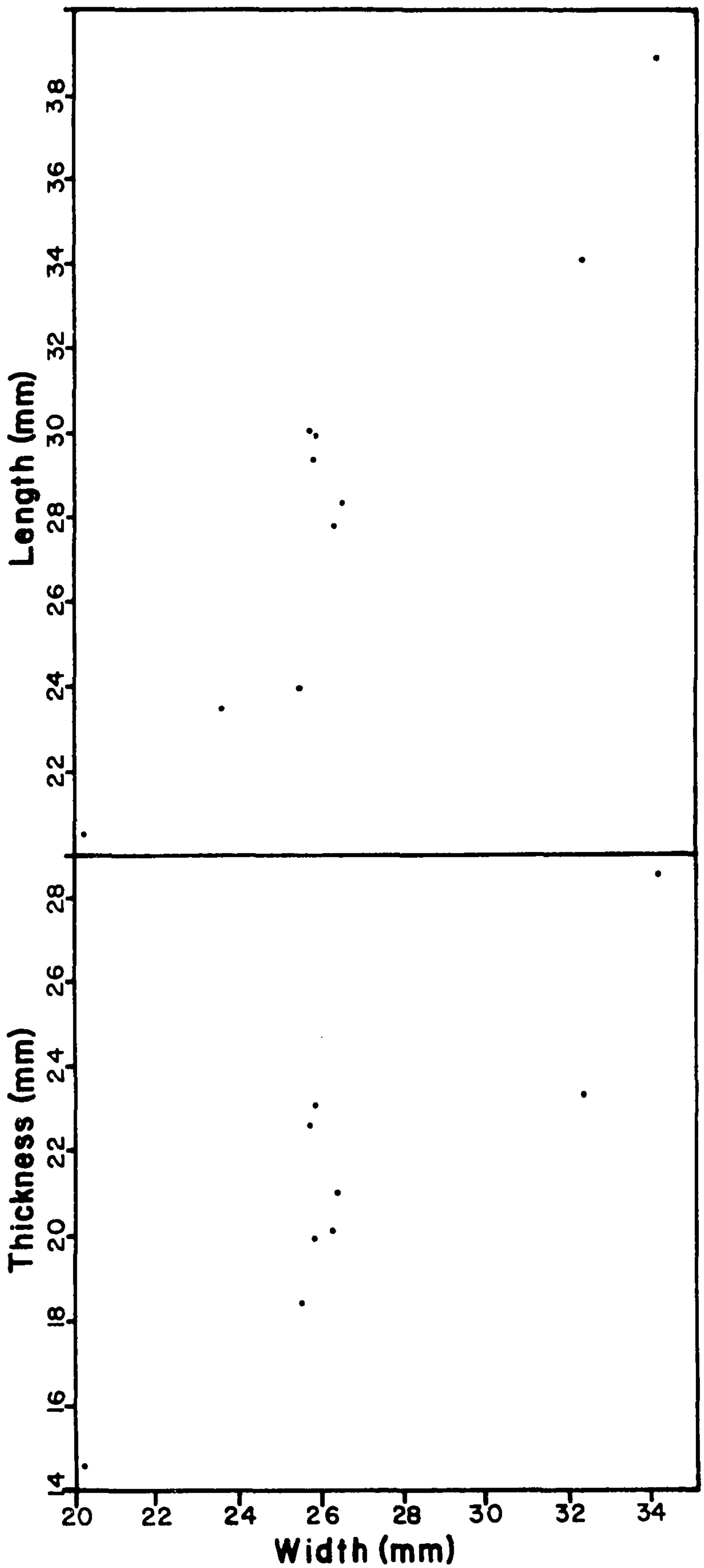
.48
.51

Text-fig. 12. Scatter diagrams of (1) length of pedicle valve against thickness and (2) length of pedicle valve, and thickness against width valve of _Martiniopsis_ ? _maia_ (Billings). G.S.C. specimens from locality 4404, St. Mary's, Ontario.

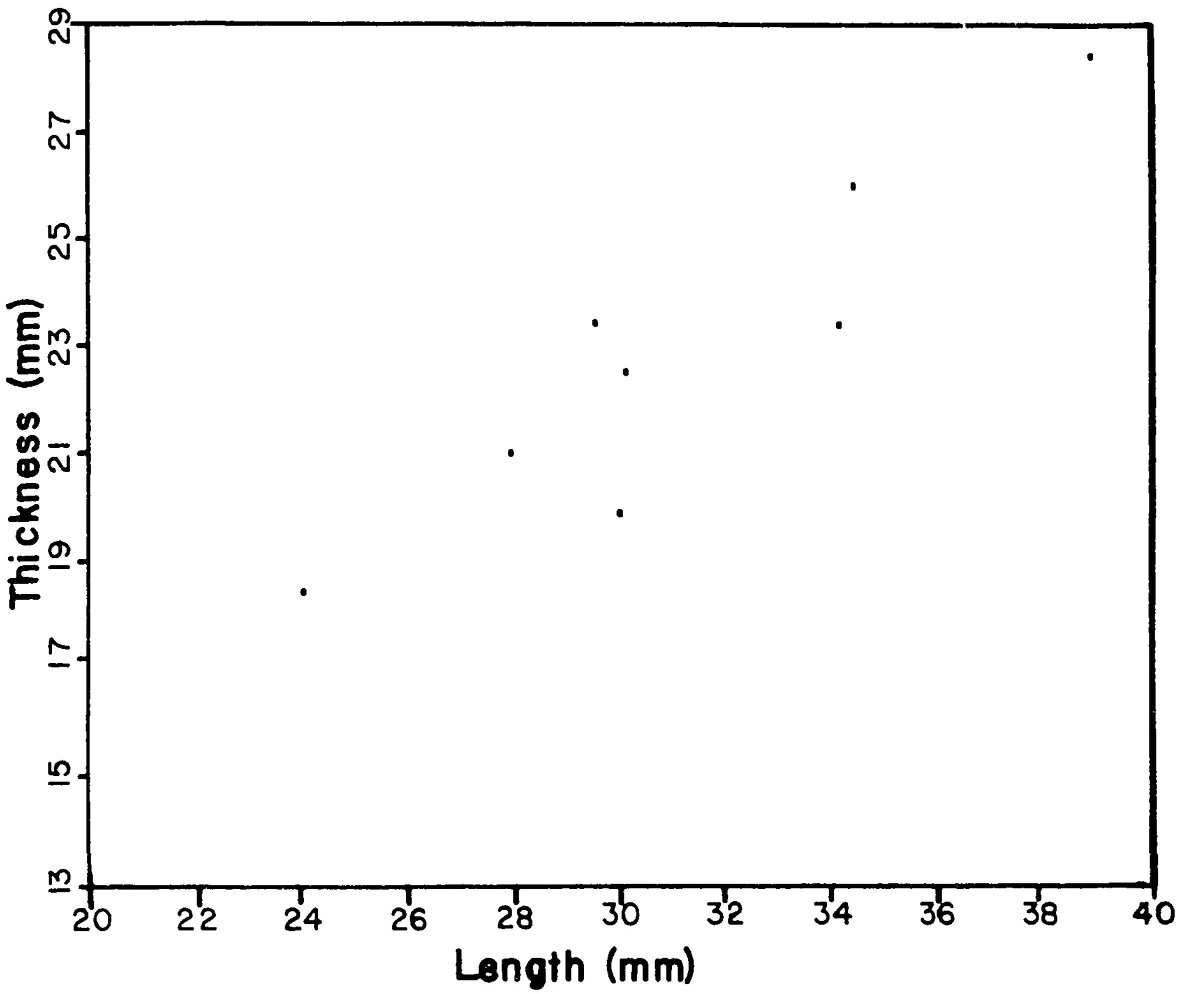

Thickness (mm)
Length (mm)
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26


Length (mm)
Thickness (mm)
Width (mm)
18
20
22
24
26
12
14
16
18
20
22
24
26

Text-Fig 13. Scatter diagrams of (1) length of pedicle valve and (2) thickness against width of *Martiniopsis* ? *maia* (Billings) from locality 85801.


Length (mm)
22 24 26 28 30 32 34 36 38
Thickness (mm)
14 16 18 20 22 24 26 28
20 22 24 26 28 30 32 34
Width (mm)

Text-Fig 14. Scatter diagram of length of pedicle valve against thickness of Martiniopsis ? maia (Billings) from locality 85801.


Thickness (mm)
29
27
25
23
21
19
17
15
13
20
22
24
26
28
30
32
34
36
38
40
Length (mm)

PHYLUM ANNELIDA

CLASS POLYCHAETA

ORDER ERRANTIA

GENUS *Drilonereisites* ELLER, 1964

Type species - *D. longicusculus* Eller, 1964

Drilonereisites apdus, n. sp.

Pl. 4 figs. 8-10

Description - Jaw elongate, consisting of anterior outcurved fang taking up to three-fourths of the specimen; one minute vertically directed denticle usually present on fang about midlength. A fossa is present on either side at the posterior end of the jaw. An upper and lower outer flange present from anterior of outer fossa to posterior edge of jaw; one inner flange also present; length in complete specimen 1.30-1.40 mm.

Remarks - There is a fairly great amount of variability in this species especially with regard to the posterior portion of the jaw. The species differs from other forms in not having minute denticles on the posterior flange.

Material and Occurrence - Holotype - UNSM 9011, locality 85801; Paratypes - UNSM 9015, locality 85802; 6" above the base of the Delaware Limestone.

GENUS *Siluropelta* EISENACK, 1939

Type species - *S. lota* Eisenack, 1939.

Siluropelta annae, n. sp.

Pl. 4, fig. 11

Description - Carrier; anterior end subquadrangular; from posterior end long extremely thin shaft extends, shaft straight or curved but very long; length .60-.90 mm; width of anterior end .10-.25 mm, width of shaft .10 mm.

Remarks - There is some variability in the carriers but they all have very long shafts when unbroken.

Material and Occurrence - Holotype - UNSM 9026, locality 85802, 22 feet above the base of the unit; Paratype - UNSM 9025, locality 85801, locality 85802, 25 feet above the base of the unit.

ORDER CONODONTIPHORIDA

FAMILY COLEODONTIDAE

GENUS Neoprioniodus Rhodes and Müller, 1956

Type species - Prioniodus conjunetus Gunnell, 1931.

Neoprioniodus sp. A

Pl. 4, fig. 12.

Description - Cusp flattened, inclined outward from bar, cusp makes angle of about 120° with bar; anticusp small; pulp cavity large, triangular with main expansion anterior of the pulp cavity, first denticle on bar .25 mm from anterior edge of cusp; both first and second denticles bent outward parallel to cusp; cusp-anticusp length about 1.00 mm; length of bar about .80 mm.

Remarks - This specimen is very similar to Prioniodus taritus Stauffer (1940) but does not have a grooved bar and is much larger. The bar in the specimen illustrated is broken. The overall length of this form is unknown.

Material and occurrence - See Appendix D.

ORDER CONODONTIPHORIDA ?

FAMILY UNCERTAIN

GENUS *Lonchodus* Pander, 1856

Type species - *Centrodus simplex* Pander, 1856

Remarks - Lindstrom (1964, pp. 173-174) discussed this genus and concluded that it is founded on fragments of other genera of conodonts (e.g., *Ligonodina*, *Lonchodina*). Webers (1966, p. 71) departed from the traditional classification and called *Lonchodus* a conularid rather than a conodont because of the resemblance of fossils of the genus to periderm fragments of conularids.

Lonchodus sp. cf. *L*. *dentatus* Stauffer, 1930

Pl. 4, figs. 13-16.

L. *dentatus* Stauffer, 1930, pp. 123-124, pl. 10, figs. 5, 6, 8.

L. sp. Stauffer, 1930, p. 127, pl. 10, fig. 14.

Description - Denticles discrete; size variable, equal to or greater than bar height; pulp cavity (not illustrated) extends into denticles from opening in base of bar; opening slightly off center of bar base; bar sides flattened slightly; base flattened or slightly undulose; bars either discrete or in pairs with the denticles of one bar filling in the spaces between denticles of the other or overlapping them; bar may be bent laterally.

Remarks - *Lonchodus* ? was reported from the Delaware Limestone of Ohio by Stewart and Sweet (1956, pp. 269-270).

Stauffer's specimens were all single bars. He did not describe their base so no definite assignment of these specimens can be made at present.

Material and occurrence - See Appendix D.

RELATIONSHIP OF FLORA AND FAUNA TO MICROFACIES

The following discussion is partially based on Text-figure 15. This Text-figure shows the distribution of microfossils at four selected exposures of the Delaware Limestone. Data used in compilation of this Text-figure are listed in Appendices A and D.

Charophyte gyrogonites occur rarely in the Delaware Limestone from St. Mary's northwestward. They are limited to the recrystallized limestone microfacies except for one specimen from the biomicrite microfacies at locality 85789.

Spores from unknown types of plants are most common in rocks cropping out in Huron county. At these localities the spores are small (less than .2 mm) and black. At the thickest exposure, locality 85793, these forms occur throughout the lower 25 feet of the outcrop. In the area around St. Mary's black spores occur in the lower portion of the Delaware and are rare in the crinoid biomicrite microfacies. A few spores occur in the upper 10 to 15 feet of the unit exposed at the St. Mary's Cement Company Quarries (localities 85801 and 85802) but they are larger (.50 mm or less in diameter) and light brown in color. Small, black spores are rare but present in exposures along and near Lake Erie. They are abundant at the base of the unit at locality 85807 in Essex county. In general, black spores are least common in the biomicrite microfacies and are commonest in the recrystallized limestone microfacies. They are rare to absent in other microfacies.

Arenaceous foraminifera are associated with almost all of the microfacies. They are most abundant in the more micritic microfacies. Test shape generally varies vertically through a section from the base of the unit. Globular, single-chambered forms occur in the lower 25 to 30 feet of the formation while plano-convex forms occur generally from this position upward through the remainder of the exposures at localities 85801 and 85802. Both types are most common in the rocks of Perth county and decrease in number to the north and to the south along the outcrop belt. They are least commonly found in the more recrystallized and more micritic microfacies.

Sponge spicules of Astraeospongium occur in the recrystallized limestone and biomicrite microfacies in approximately the basal 30 feet of the Delaware Limestone along the outcrop band. They are rare or absent in the very highly calcitic and micritic portions of the unit as well as in the burrowed and disrupted microfacies and the crinoid biomicrite microfacies.

Rare stromatoporoids have been found only in the lower 10 to 20 feet of the unit in the St. Mary's area. Rugose corals, however, are very abundant in some strata in the lower 20 to 25 feet. The most widespread form is Heterophrentis ? sp. Other species generally occur only in local areas. Tabulate corals are found in the more micritic microfacies from Perth county southward.

Fragments of bryozoan zooaria are common in about the lower 20 feet of the formation in the St. Mary's area. They occur as microscopic or megascopic fragments in the biomicrite microfacies and diminish in number to the north and to the south from Perth county.

Brachiopods occur in nearly all of the microfacies of the area. Particularly widespread and often abundant are Brevispirifer lucasensis Atrypa reticularis, Spinatrypa spinosa, Megastrophia concava, and Leptaena rhomboidalis. Of these species, the first three are found most commonly in the biomicrite microfacies but occur in most others. The latter two forms are locally abundant in the biomicrite microfacies and rare or absent in the others. Species of brachiopods that are restricted to specific outcrop areas include Cyrtina umbonata var. alpenaensis, Cyrtina hamiltonensis and Nucleospira concinna in the areas in Huron county, and Martiniopsis ? maia in Perth county. Longispina deflectus occurs only in the brachiopod biomicrite microfacies of Perth county and an unidentified species of "Chonetes" occurs in Huron and Perth counties in the lower portions of the unit.

Pelecypods are poorly preserved and are generally difficult or impossible to identify with any certainty below the family level. They are most common in Huron county in the recrystallized limestone. Conocardium is present in the lower few feet of the Delaware Limestone in Perth county but never in great abundance.

Gastropods as well as pelecypods are most abundant in Huron and Perth counties. They are poorly preserved and impossible to identify below the class level. Although most of them are low-spired forms, some high-spired types have been observed in thin-sections. Both forms occur in both the recrystallized limestone and biomicrite microfacies.

The only cephalopod collected was from locality 85801. It occurs in the lowermost portion of the biomicrite microfacies.

Tentaculites sclariformis, a cricoconarid, and an abundant species in the Delaware Limestone of Ohio, is rare in Ontario. It occurs within a few feet of the base of the unit in Perth county and one specimen comes from a position almost 30 feet above the base of the formation at locality 85793 in Huron county. In both counties this species occurs only in the biomicrite microfacies.

Although crinoid debris constitutes a major portion of the fossil grains in the Delaware, few complete specimens of crinoids have been reported to date by other workers. Only two specimens of crinoids with the crown at least partially intact were collected. Both occur in the biomicrite microfacies near Lake Erie (localities 85804 and 85806). The microfacies in this area has few fossils in a largely micritic matrix and may be an indicator of quieter water conditions where these fossils could accumulate with better chances for good preservation.

Holothurian sclerites of Protocaudina are common in some horizons from 3 feet to about 20 above the base of the unit in the St. Mary's area. They are primarily restricted to the biomicrite microfacies but they also occur in the upper portions of the recrystallized limestone microfacies in Huron county. These sclerites seem to be restricted to these two rock types. Support for this hypothesis comes from their occurrence only in higher portions (26-29 feet above the base) of the outcrops at locality 85793.

Scolecodonts are most common in Perth county and generally decrease in abundance to the northwest and southeast. They are, however, locally abundant in these latter areas (e.g., localities 85790 and 85806). One genus, Drilonereisites, is restricted in its range to approximately the lower 20 feet of the formation and usually occurs in the biomicrite microfacies; however, it is present in the recrystallized limestone microfacies in Huron county. Another genus, Siluropelta, has been obtained from 22 to 25 feet above the base of the formation at localities 85801 and 85802.

The majority of the conodont species identified are either fragmental or only locally abundant. The most widely distributed genera are Polygnathus, Icriodus, Angulodus, and Hindeodella. Polygnathus *linguiformis* is common in all microfacies and can be found at most localities. *Polygnathus* sp. is rare and generally occurs higher than 20 feet above the base of the unit in the more micritic microfacies. *Icriodus angustus* is also rare and is found only in the biomicrite microfacies at localities 85798 and 85801. *I. nodosus* is the most widespread species of this genus and occurs in all microfacies. It is most common at the Perth county exposures. *I. expansus* occurs in Perth county in the biomicrite and crinoid biomicrite microfacies as does *I. cymbiformis*. The only specimens of *I. latericrescens* n. subsp. A found occur at locality 85806. Ferrigno (1968, p. 23) reports *I. latericrescens* n. subsp. A in the lower 2 feet of the Delaware Limestone at locality 85801. Species of *Angulodus* and *Hindeodella* occur in all microfacies.

Fish scales and denticles of the various species listed are either widely distributed (e.g., *Cheiracanthoides comptus*, *Onychodus sigmoides*), found primarily in Perth county and in limited numbers in the outcrops near Lake Erie (e.g., *Acanthoides dublinensis*, *Ohiolepis stewartae*), found in Perth and Huron counties (e.g., *Acanthoides sciotoensis*), or found only locally in limited numbers. Most of the fish remains are limited to the biomicrite microfacies and the crinoid biomicrite microfacies.

Several conclusions can be drawn from a study of Text figure 15. The majority of the microfossil groups are most common in the biomicrite microfacies. The microfossil distribution generally appears to be facies controlled. Shifts in microfossil distribution generally parallel the transgressive shift of the microfacies noted later.

CORRELATION

Fossils Useful for Correlation and Zonation over Large Areas

Table 2 includes a check list of taxa common to the Delaware Limestone of Ontario and formations which previous workers have regarded as correlative with the Delaware in Michigan, Ohio, and New York as well as the subjacent Columbus Limestone of Ohio and Moorehouse Member of the Onondaga Formation in New York. Faunal lists used for compilation of this part of Table 2 were obtained from Stauffer (1909), Bassett (1935), Stewart (1938), Wells (1944b), Stewart and Lampe (1947), Oliver (1954), Stewart and Sweet (1956), Oliver (1956), Eller (1964), and Klapper and Ziegler (1967).

Study of the check list in Table 2 reveals that of the taxa found in the Delaware Limestone of Ontario certain major groups are generally limited to one or two formations in adjacent areas of Ohio and Michigan while other groups are geographically and stratigraphically widespread. Protozoans and fish, for example, are reportedly limited to the Columbus and Delaware formations of Ohio. Annelids are common to the Delaware and Dundee formations whereas the coelenterates are generally restricted to the Dundee Formation alone. Plants, as well as some of the brachiopods, pelecypods, arthropods, cricoconarids and conodonts occur in all three formations. Some brachiopods, cricoconarids and conodonts occur in the Seneca and Moorehouse Members of the Onondaga Formation of New York as well as the Delaware, Dundee and Columbus formations.

The restriction of a group common to the Delaware Limestone of Ontario to only one or two of the formations in adjacent areas may be due to a variety of causes. Some groups may have narrow stratigraphic or geographic ranges. Others (e.g., protozoa, annelids, and fish) have not been studied as yet by workers outside Ontario but may be present. Coelenterate distributional restrictions may be due more to a reflection of variations in depositional environment from one area to another than to a lack of study of the group.

The check list in Table 2 does not show that many of the taxa have long ranges that make them of little use in correlation and zonation. Relatively few of the species listed in Table 2 have been used in the past as index fossils and zonal indicators.

Brachiopods were regarded by Stauffer (1909), Stewart (1955), and Wells (1947) as a useful group of fossils for correlation and zonation of the Middle Devonian formations of Ontario, Michigan, and Ohio. They mention four species (i.e., "*Martiniopsis*" *maia*, *Mucrospirifer consobrinus*, *Brevispirifer lucasensis* and *Atrypa costata*) as key brachiopods for correlation. As previously discussed, each of these four species has been reported from Ontario. On the basis of information obtained during this study at least three and possibly all four of the forms occur in the Delaware Limestone of Ontario but are restricted to certain microfacies and are only of use in establishing local range zones within the formation.

Only one species of coelenterate, *Hexagonaria truncata*, is restricted to the Delaware Limestone of Ontario and the Dundee Limestone of Michigan. All of the other species occur in younger or older Devonian formations as well as in the Delaware and correlative units.

Icriodus latericrescens n. subsp. A, Incriodus angustus and several species of Polygnathus have proven useful for correlation and zonation of the Delaware Limestone in Ohio and adjacent areas. Other conodonts are of only limited use for these purposes.

Zonation of the Delaware Limestone in Ohio

Stauffer (1909, pp. 363-365) subdivided the Delaware Limestone of central Ohio into a series of five local zones lettered I-M. He named the middle three zones on the basis of characteristic fossils as the Tentaculites sclariformis (J), Grammysia bisulcata (K), and Hadrophyllum d'orbignyi (L) zones.

Wells (1947, p. 121) called Stauffer's unnamed zone I the "Martiniopsis" maia zone but left Stauffer's zone M unnamed. He also plotted hemerae and teilzones for two distinctive spiriferids, "M". maia and Mucrospirifer consobrinus.

The five zones established by Stauffer are only recognizable in central Ohio. Stewart (1955, p. 158) reports the occurrence of Stauffer's key zonal species at Sandusky, Ohio, but states that they do not occur there in the zonal sequence found to the south. Two of these zonal species, Tentaculites sclariformis and Martiniopsis maia, also occur in Ontario but Stauffer's zonation can not be recognized in Ontario.

Zonation of the Delaware Limestone in Ontario

Local range zones for each important fossil taxon found during the course of this study at locality 85801 have been determined from the data in Table 2, Appendix D, and from Ferrigno's data obtained during a study of the Delaware Limestone at the same locality in 1968. Text-figure 16 shows the stratigraphic ranges of twelve of the fossil groups that are characteristic of the Delaware Limestone in Ontario.

The eastern outcrop belt of the Delaware Limestone at St. Mary's can be divided into three zones using spores and one conodont species. The two spore zones are informal zones based on two distinct sizes of spores that are colored differently and may each consist of more than one species. Text-figure 17 shows the position of these three zones with respect to the base of the formation. From the base upward the zones are the *Icriodus latericrescens* n. subsp. A Zone, the "lower spore zone" and the "upper spore zone."

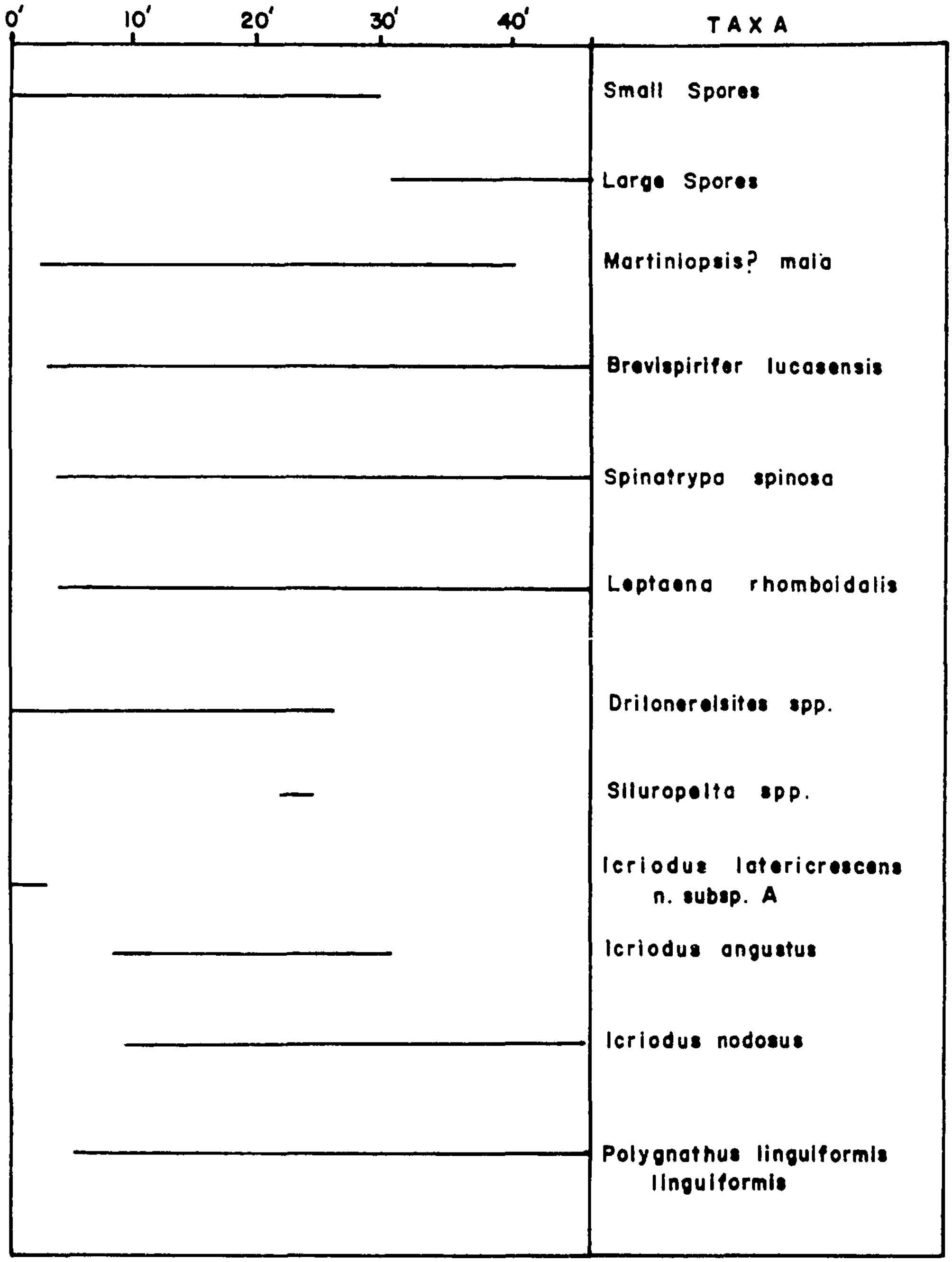
The *Icriodus latericrescens* n. subsp. A Zone is characterized by the presence of this species. It occurs from locality 85801 southeastward to the exposures along Dry Creek near Lake Erie (Locality 85806). The top of the zone lies within three feet of the base of the Delaware Limestone at the former locality but extends upward into higher strata at the latter locality. The zone is not present at localities northwest of St. Mary's (Locality 85801).

The "lower spore zone" is based on the occurrence of small black spores belonging to the genus *Tasmanites*. The zone extends upward from the top of the *I. latericrescens* n. subsp. A Zone for a distance of 25 to 27 feet. Spores of this zone are common from outcrops at the localities at and near Goderich, Ontario, southeastward to locality 85801. Farther to the southeast at locality 85806 only a few specimens occur at one horizon.

Spores characteristic of "the lower spore zone" occur at locality 85807 at Amherstberg, Ontario. No detailed examination of the micro-

TEXT-FIGURE 16

RANGES OF SELECTED FOSSILS AT LOCALITY 85801



0' = Base of the Delaware Limestone; numbers indicate height above base of formation.

fossils from this locality has been made during this study so the author can not be certain whether the zones established for the eastern outcrop belt can be recognized there.

The "upper spore zone" is present only in the vicinity of St. Mary's at localities 85799, 85801 and 85802. This zone is based on the occurrence of large yellowish-brown spore exines belonging to the genus *Tasmanites*. The zone occurs 30 or more feet above the base of the unit.

While certain other fossils are typical of the formation (e.g., *Spinatrypa spinosa*, *Brevispirifer lucasensis*, *Martiniopsis ? maia*) they are either restricted to certain facies or they are limited in occurrence to a few localities. None of them are of use in zonation of the unit on a broader basis than local range zones.

Regional Correlation

Regional correlation of rocks equivalent in age to the Delaware Limestone of Ontario can be accomplished in part using the occurrence of the Tioga Bentonite. Sanford (1967, p. 987) reported this bed 60 to 100 feet above the base of the Moorehouse Member of the Onondaga Formation (i.e., the lateral equivalent in part of the Delaware Limestone according to Sanford) after a study of cuttings and well data from Norfolk and Oxford counties, Ontario, and from beneath Lake Erie near Long Point. Sanford (1967, fig. 3) indicates that this bentonite separates his Seneca and Moorehouse Members. Unfortunately no bentonite has been found at surface outcrops during this study or in the subsurface by Sanford farther to the northwest.

Oliver and others (1967, pp. 1006-1007), in a compilation of previous work, have reported the Tioga Bentonite between the Seneca and Moorehouse

Members of the Onondaga Formation in New York and Pennsylvania and between the Delaware and Columbus Limestones in northern Ohio. Meents and Swann (1965, p. 10) found the Tioga Bentonite near the top of the Jeffersonville Limestone in southern Indiana. This bentonite has also been reported in the upper Grand Tower Limestone in Illinois and the upper Jeffersonville Limestone in Kentucky by Collinson and others (1967, p. 942).

At this time the author regards only 7 of the 128 taxa collected during this study as of any use in regional correlation of the Delaware Limestone in Ontario with units in adjacent parts of the United States. The remaining 121 taxa are either forms having wide range zones that include formational occurrences above and below the Delaware Limestone in areas outside of Ontario, are forms that have not been studied in detail by previous authors, or are forms that have been only tentatively identified during this study. Hexagonaria truncata, Brevispirifer lucasensis, Spinulicosta spinulicosta, Martiniopsis ? maia, Spinatrypa spinosa, Incriodus latericrescens n. subsp. A and Icriodus angustus are the species judged to be of importance in correlation of the Delaware Limestone of southwestern Ontario with formations in other areas.

Hexagonaria truncata was found at locality 85801. It has been reported by Stewart (1938, p. 52) from the Dundee Limestone in Lucas county, Ohio. Martiniopsis ? maia, Spinatrypa spinosa, Spinulicosta spinulicosta, and Brevispirifer lucasensis found during this study in the Delaware Limestone of southwestern Ontario and reported by Best (1953) and Stauffer (1915) as restricted to that formation in Ontario occur in the Delaware Limestone of central Ohio (Stauffer, 1909). Stewart (1955) reports the occurrence of Brevispirifer lucasensis, Spinulicosta

spinulicosta, and possibly Spinatrypa spinosa from the Dundee Limestone of Ohio and Michigan. Cooper and others (1942, p. 1763) report B. lucasensis from the upper Grand Tower Limestone of Illinois. Savage (1910, p. 129) reported Spinulicosta spinulicosta from the upper Grand Tower Limestone in Illinois and the upper Jeffersonville Limestone in Indiana. Campbell (1942, pp. 1060-65) reported S. spinulicosta from members of the North Vernon Limestone in southern Indiana. The occurrence of one, or more of these stratigraphically restricted species supports correlation of the formations with the Delaware Limestone of Ontario.

The conodonts Icriodus latericrescens n. subsp. A and I. angustus have not been found in the higher exposed portions of the Delaware Limestone in southwestern Ontario during this study but do occur in the lower part of it at some localities. Correlation of this formation with formations in other areas can be made on the basis of the uppermost stratigraphic occurrence of these two species. According to reports by Klapper and Ziegler (1967), Ramsey (1969), and Klapper and others (in press) the uppermost stratigraphic limit of these two species is in the Delaware Limestone of Ohio, the Dundee Limestone of Michigan and Ohio, the upper Jeffersonville Limestone and the Speed and Silver Creek Members of the North Vernon Limestone of Indiana and the upper Grand Tower and lower Lingle Limestone of Illinois.

Icriodus angustus does not occur in New York according to Klapper and Ziegler (1967) but Icriodus latericrescens n. subsp. A does. Its uppermost stratigraphic range is at the top of the Seneca Member of the Onondaga Formation. A number of species of Polygnathus occur stratigraphically higher than I. latericrescens n. subsp. A and are restricted to the Cherry Valley Member of the Marcellus Formation in New York according to Klapper and others (in press). One of these species, *P. eifelius*, has been reported from the Delaware Limestone at St. Mary's, Ontario, by Ferrigno (1968).

Some differences in regional correlation of units have arisen that seem to be due to the use of different groups of taxa in correlating. A particular problem regards correlation of the uppermost part of the Jeffersonville Limestone in southern Indiana. On the basis of conodont ranges Rexroad and Orr (1967, pp. 39-74) have correlated the upper Jeffersonville with the lower Delaware and Dundee Limestones. Orr (1968, pp. 3754B-3755B) added further evidence from conodont studies in support of this correlation. Fagerstrom (1968), using the occurrence of brachiopods has correlated the *Paraspirifer acuminatus* Zone of the upper Jeffersonville with the Anderdon Limestone of the Detroit River Group. These differences in interpretation remain to be clarified.

On the basis of the presence of the Tioga Bentonite and on the common occurrence of faunal elements including those noted above, the Delaware Limestone of southwestern Ontario is correlated by Oliver and others (1970) and Klapper and others (in press) with the Delaware Limestone of Ohio, the Dundee Limestone of Michigan and Ohio, the Cherry Valley Member of the Marcellus Formation and the Seneca Limestone Member of the Onondaga Formation of New York, the upper Grand Tower and lower Lingle Limestones of central and southern Illinois, the upper Jeffersonville Limestone (above the occurrence of the Tioga Bentonite) and the Speed and Silver creek Members of the North Vernon Limestone of Indiana. These correlations are supported by the stratigraphic distribution of the previously noted members of the fauna collected during this study. The faunas of these formations need to be studied in greater detail before more precise correlations can be made. Text-figure 18 is a correlation chart of the formations discussed in this section.

The Delaware Limestone of southwestern Ontario is shown in Text-figure 18 as equivalent to only the lower portions of the Cherry Valley Member of the Marcellus Formation, the Silver Creek and Speed Members of the North Vernon Limestone, the Lingle Limestone, the Dundee Limestone, and the Delaware Limestone of Ohio. This interpretation is based on three facts: 1. only outcrops of the Delaware Limestone in southwestern Ontario have been studied in detail by this author; 2. the upper portion of the Delaware Limestone in Ontario is known only from the subsurface; and 3. no major paleontologic studies have been made on the upper portions of the formation in Ontario.

Intercontinental Correlation

Intercontinental correlation of Middle Devonian rocks is generally based on the occurrences of conodonts and cephalopods. Occurrences of conodonts from the Delaware Limestone of Southwestern Ontario have been compared to conodonts present in the standard European conodont zones that others have used for intercontinental correlations. In the Delaware Limestone of Ontario _Polygnathus linguiformis_, _Icriodus_ cf. _I. expansus_, _I. nodosus_, and _I. cymbiformis_ are also present in Middle Devonian stages in Germany according to Bischoff and Ziegler (1957). _Icriodus angustus_ and _I. latericrescens_ n. subsp. A have not been reported from Europe up to this time and seem to be North American forms (see Klapper and Ziegler, 1967) for a discussion of this problem.

Klapper and Ziegler (1967, p. 72, Figure 2) show the ranges of Icriodus angustus and Icriodus latericrescens n. subsp. A. The range of I. latericrescens n. subsp. A ends in the middle Eifelian while I. angustus extends to the end of the middle Eifelian. Ramsey (1969, p. 17) suggested the Delaware Limestone of central Ohio to be upper Eifelian after study of the conodont fauna of the formation.

Both Klapper and Ziegler (1967, p. 72) and Ferrigno (1968, p. 32) correlate the lower part of the Delaware (= Dundee) Limestone of North America with the Spathognathodus bidentatus Zone of Europe on the basis of rare conodonts associated with the highest stratigraphic occurrence of Icriodus latericrescens n. subsp. A. Since I. latericrescens n. subsp. A occurs in only the basal few feet of the Delaware Limestone in Ontario the lower portion of the Delaware can probably be correlated with this zone. Klapper and Ziegler (1967) and Ferrigno (1968) suggest that the remainder of the Delaware (= Dundee of their usage) falls within the S. bidentatus and Polygnathus kocheliana Zones on the basis of the absence of I. latericrescens n. subsp. A, the presence of I. angustus and other rare forms, and the absence of I. latericrescens. At the present time no subsurface paleontological data are known in Ontario that would help in determining whether the uppermost portion of the unit is restricted to the Eifelian or can be included in the lower part of the Givetian stage.

Oliver and others (1970) place the top of the Delaware Limestone (their Dundee Limestone) at the top of the Polygnathus eifelia Zone while Klapper and Ziegler (1967) place the top of the formation at the base of this zone. Oliver and others (1970) list the standard European

Conodont zones in a different fashion than that used by Klapper and Ziegler yet have used the work of the latter authors to compile their list of zones. The list of zones reported by Oliver and others is in error (Klapper, 1971, personal communication).

POSSIBILITY OF A TRANSGRESSION OF THE DELAWARE LIMESTONE OVER UNDERLYING UNITS

On the basis of the relationship of the contact between the lower two biostratigraphic zones to the base of the Delaware Limestone, the presence of basal sands in the formation, the unconformable nature of the base of the Delaware, and the overlapping nature of the microfacies it is possible that the Delaware Limestone is a transgressive unit.

Text-figure 17 shows the position of the *Icriodus latericrescens* n. subsp. A Zone and the lower spore zone relative to the position of the base of the Delaware Limestone and of a datum established at 25 feet above the base of the formation. The top of the *I. latericrescens* n. subsp. A Zone approaches the base of the formation in a northwesterly direction. The top of the lower spore zone approaches the datum at 25 feet above the base of the unit in a northwesterly direction, too. This change in position of two established biostratigraphic zones presumably having a time-parallel contact with respect to two known stratigraphic positions within the formation supports the transgression hypothesis.

Summerson and Swann (1970) reviewed the distribution of Devonian sand on the North American craton including the sands at the base of the Delaware and Dundee Limestones. They (1970, p. 486) suggest that the sands along hiatuses are reworked concentrations formed during readvances of seas. Their correlation chart (1970, pp. 472-473) also shows the Delaware and correlative units as transgressive.

Not only is there sand present at the base of the Delaware Limestone in Ontario but there is also often a conglomerate or breccia derived from the underlying Detroit River Group present as well basal quartzose microfacies of this report in Appendix A). This is strong evidence of an erosion surface at the base of the formation.

Text-figure 6 shows that the three major microfacies groups above the basal quartzose microfacies tend to transgress each other in a northwesterly direction possibly suggesting a transgression over the area. Upitis (1964) during a petrographic study of the formation at locality 85801 reported a progressive upward decrease in the coarseness of the rock texture and suggested a gradual deepening of water over the area through time as the sediment of the Delaware accumulated. This observation may tie in with the shift in microfacies reported in this work and may add further support to the hypothesis of a transgression.

At the present time the strongest piece of evidence obtained during this study in support of a transgression of the Delaware Limestone over underlying rock is the shift in position of the tops of the biostratigraphic zones with respect to the two lithologic datum planes established at the formation base and at 25 feet above the formation base (see Text-figure 17). More evidence will have to be obtained to confirm (if possible) the hypothesis.

If the above interpretation is correct, it is possible that the transgression was from the southeast to the northwest across the peninsula of southwestern Ontario since the datum plane (e.g., base of the Delaware) transgresses the lower two biostratigraphic zones of the formation in a northwesterly direction.

CONCLUSIONS

1. The rock unit stratigraphically above the Detroit River Group in southwestern Ontario probably should be called the Delaware Limestone because the unit is continuous beneath Lake Erie with the Delaware Limestone of central and northern Ohio and because the name Delaware has been applied to this formation for a far longer period of time than any other name commonly used to designate it.
2. The Delaware Limestone can be subdivided into a number of microfacies by microscopic study of the formation. These microfacies are the basal quartzose, recrystallized (crinoid, spore) limestone, biomicrite, crinoid biomicrite, coral biomicrite, brachiopod biomicrite, crinoid biomicrite, coral biomicrite, brachiopod biomicrite, burrowed biomicrite, and micrite microfacies. For convenience these microfacies can be combined into four large microfacies categories. The basal quartzose microfacies remains as a separate category. All of the partially recrystallized groups can be placed into the recrystallized limestone microfacies. The biomicrite, crinoid biomicrite and coral biomicrite microfacies can be grouped together into a biomicrite microfacies on the basis of the presence of microcrystalline calcite matrix in the rocks. The remainder of the microfacies can be grouped into a burrowed biomicrite and biomicrite microfacies on the basis of marked evidence of burrowing, higher than usual insoluble residue content, and relatively high percentage of fossil grains over other allochems.

3. The basal quartzose microfacies can be recognized from the vicinity of St. Mary's Ontario, northwestward to the vicinity of Goderich, Ontario. The recrystallized limestone microfacies is of major quantitative importance in the Delaware Limestone at Goderich and decreases in abundance toward St. Mary's. The biomicrite microfacies is quantitatively most important at St. Mary's. The burrowed biomicrite microfacies increases in abundance from St. Mary's to outcrops near the Lake Erie shore.
4. Investigation of the common brachiopods of the Delaware Limestone in Ontario most frequently used in earlier correlations (i.e., Martiniopsis ? maia, Brevispirifer lucasensis, and Spinatrypa spinosa) with formations in adjacent regions of the United States has led the author to the conclusion that these forms should be collected on a regional basis and should be completely restudied.
5. Three range zones are established in the Delaware Limestone that are of importance in zonation of the eastern outcrop belt of the formation. From the base of the formation upward in the St. Mary's area these zones are the Icriodus latericrescens n. subsp. A Zone, the "lower spore zone," and the "upper spore zone." The upper two zones are informal zones defined by spores of two different sizes and types of preservation. Each of these zones may be based on the occurrence more than one spore species. The I. latericrescens n. subsp. A Zone occurs from St. Mary's southeastward to the exposures near Lake Erie. The "lower spore zone" can be recognized along all of the eastern outcrop belt from Goderich near Lake Huron southeastward to the exposures along Dry Creek near Lake Erie. The "upper spore zone" can only be recognized in the St. Mary's area.

6. On the basis of the common occurrence of a number of index fossils and the presence of the Tioga Bentonite outcrops of the Delaware Limestone of Ontario are here correlated with portions of the Delaware Limestone of Ohio, the Dundee Limestone of Michigan and Ohio, the Seneca Limestone Member of the Onondaga Formation and the Cherry Valley Limestone Member of the Marcellus Formation of New York, the uppermost part of the Jeffersonville Limestone (above the Tioga Bentonite) and the Speed and Silver Creek Members of the North Vernon Limestone of Indiana and the upper Grand Tower and the lower Lingle Limestones of Illinois.

   These correlations must be considered as tentative because regional studies and re-evaluations of the biostratigraphic significance of the conodonts and brachiopods used for correlations are only now being undertaken by other workers. More precise correlations probably will be made after these studies have been completed.

   Correlation of the unexposed upper beds of the Delaware Limestone in Ontario with other units will remain questionable until a comprehensive study of the fauna and flora in the subsurface rocks of the formation is undertaken and completed.

7. The Delaware Limestone in Ontario may be transgressive across the underlying Detroit River Group. Although the relationship of the lower two zones within the unit to the lithology of the unit suggests a transgression, verification of this hypothesis will probably only come after additional data have been accumulated.

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APPENDIX A

Lithologic Descriptions of Samples of the Delaware Limestone From Outcrops in Southwestern Ontario

The following lithologic descriptions are the result of studies of polished sections and thin sections, both of which are housed in the collections of the University of Nebraska, Department of Geology.

Carbonate rock names are derived from Folk (1962) with no modification. The relative abundances of matrix, cement, allochems (or grains), and pore space are estimated and recorded for each thin-sectioned specimen.

Rock colors for both fresh (i.e., unweathered) surfaces and weathered surfaces are recorded using the colors given in the Geological Society of America Rock-Color Chart. All of the colors were obtained by comparison of wetted specimens in natural light with the chart colors. When the rock color does not fit any color on the chart a range of colors is listed within which the rock color seems to fit.

All localities are described from the top of the outcrop to its base. An * is used when the base of the outcrop coincides with the base of the unit. The top of the Delaware Limestone is not visible in Ontario at any presently known outcrop.

Locality 85789 - Point Farms Provincial Park, South of

Locality 85790 along Small Stream

# Feet Above Base	Description of Lithology
6	Biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1) to light olive gray (5Y6/1); matrix 40-50%, grains 50-60%, pore space 0-10%; grains brachiopod, bryozoan, coral, crinoid and unidentified skeletal fragments; grain size .8 cm or less, usually less than .1 cm; bedding thick.
5	Crinoid biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - light gray (N7; matrix 30-40%, grains 55-65%; pore space 0-10%; grains primarily crinoid debris with brachiopod and undetermined skeletal debris; grain size .5 cm or less; bedding thick.
4	Brachiopod recrystallized limestone; color, unweathered - olive gray (5Y4/1) weathered - light olive gray (5Y6/1); matrix 55-65%, cement 5-15%, grains 25-35%; grains primarily brachiopods whole and single shells with crinoid and coral debris; grain size from more than 1.5 cm to less than .1 cm; bedding thick with a few wavey discontinuous black laminae; dolomite rhombs.
3	Recrystallized limestone; color, unweathered - olive gray (5Y4/1); weathered - light olive gray (5Y6/1); cement 40-50%, grains 50-60%, pore space 0-5%; grains whole and partial brachiopods and large coral and crinoid fragments; grain size from more than 2 cm to less than .1 cm; bedding thick with some evidence of burrowing; dolomite rhombs.
2	Recrystallized limestone; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light gray (N7); cement 40-50%, grains 50-60%, pore space 0-10% grains brachiopod, crinoid and undetermined skeletal debris; grain size from more than 2 cm to less than .1 cm; bedding thick. dolomite rhombs.
1.5	Dolomitic recrystallized limestone; color, unweathered - moderate yellowish brown (10YR5/4), weathered-yellowish gray (5Y8/1); matrix 0-10%, cement 15-25%, grains 55-65%, pore space 10-20%; grains bryozoan, crinoid, coral, brachiopod and unidentified debris; grain size from more than .4 cm to less than .1 cm; bedding thick with thin brown laminae; stylolite present; some minor silica replacement in a few fossils; dolomite rhombs.

1 <u>Dolomite recrystallized limestone</u>; color unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 5-15%, cement 45-55%, grains 35-45%, pore space 0-5%; grains primarily undetermined but with crinoid and brachiopod skeletal fragments; grain size .3 cm or less; bedding thick; colomite rhombs.

0 <u>Dolomite recrystallized limestone</u>; color, unweathered - pale yellowish brown (10YR6/2), weathered very pale orange (10YR8/2) to pale yellowish brown (10YR6/2); cement 30-40%, grains 45-55%, pore space 5-15%; grains brachiopod, crinoid and many undetermined fragments; grain size 1.5 cm or less, generally .1 cm or less; bedding thick; dolomite rhombs.

Locality 85790 - Point Farms Provincial Park South of

Bathing Beach 100 Yards

# Feet Above Base	Description of Lithology
6	Brachiopod biomicrite; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 50-60%, cement 30-40%, grains 10-20%; grains brachiopod valves; grain size .5 cm or less; bedding thick; dolomite present in rhomb form.
5	Biomicrite; color, unweathered - olive gray (5Y4/1), weathered light olive gray (5Y6/1); matrix 60-70%, grains 30-40%; grains trilobite, brachiopod, crinoid and undetermined debris; grain size .7 cm to less than .1 cm; bedding medium.
4	Biomicrite; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 70-80%, grains 20-30%; grains bryozoan, brachiopod, crinoid skeletal debris; grain size 2 cm to less than .1 cm; bedding thick; biosparaite lens present.
3	Recrystallized limestone; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); cement 60-70%, grains 20-30%; grains crinoid and coral debris; grain size 3 cm to less than .1 cm; bedding thick; ghosts of crinoid ossicles recrystallized.
2	Biosparite; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); cement 60-70%, grains 20-30%; grains crinoid and unidentified debris; grain size .2 cm or less; bedding thick; ghosts of fossils.
1	Recrystallized limestone; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); cement 60-70%, grains 20-30%; grains crinoid and unidentified debris; grain size .2 cm or less; bedding thick; ghosts of fossils.
0	Recrystallized limestone; color, unweathered - olive gray (5Y4/1); weathered - light olive gray (5Y6/1); cement 90%; grains 10%; bedding thick; primarily calcite rhombs.

Locality 85791 - Bogies Beach Along Stream

# Feet Above Base	Description of Lithology
18	Crinoid biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 35-40%; cement 5-15%, grains 45-55%; grains primarily crinoid ossicles with brachiopod, coral, and undetermined skeletal fragments plus spores; grain size 1 cm to less than .1 cm; bedding thick massive.
17	Covered
16	Crinoid biomicrite; color, unweathered - olive gray (5Y4/1); weathered - yellowish gray (5Y8/1); matrix 20-30%; grains 70-80%; grains crinoid ossicles; grain size .5 cm to .1 cm; bedding thick.
15	Biomicrite; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light gray (N7); matrix 30-40%, grains 60-70%; grains primarily crinoid and unidentified debris; grain size .1 cm or less; bedding thick; debris partially recrystallized.
14	Biomicrite; color, unweathered - olive gray (5Y4/1), weathered - medium light gray (N6); matrix 30-40%, grains 60-70%; grains crinoid ossicles; grain size .5 cm to less than .1 cm; bedding thick.
13	Biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 35-45%, grains 55-65%; grains crinoid ossicles and skeletal debris; grain size .5 cm to less than .1 cm; bedding thick; debris recrystallized.
12	Biomicrite; color unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 15-25%, matrix 25-35%; grains 40-50%; pore space 0-5%; grains coral, brachiopod, crinoid, bryozoan and undetermined skeletal debris; grain size 2.5 cm to less than .1 cm; coarser grained at base; bedding thick.
11	Biomicrite; color, unweathered - light olive gray (5Y6/1); weathered - yellowish gray (5Y8/1) to light olive gray (5Y6/1); matrix 15-25%, matrix 25-35% grains 45-50%, pore space 0-5%; grains brachiopod, crinoid, and undetermined skeletal debris; grain size .6 cm to less than .1 cm, most less than .1 cm; bedding thick.

10 Biomicrite; color, unweathered - light olive gray (5Y6/1); weathered light gray (N7); matrix 50-60%, grains 40-50%; grains brachiopod, crinoid and small unidentified skeletal debris; grain size 1 cm to less than .1 cm; bedding thick.

9 Biomicrite; color, unweathered - dark yellowish brown (10YR4/2), weathered - light olive gray (5Y6/1); matrix 45-55%, grains 45-55%; grains coral, brachiopod, crinoid and undetermined skeletal debris; grain size 1 cm to less than .1 cm; bedding thick.

8 Biomicrite; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light gray (N7; matrix 75-85%, grains 15-25%; grains brachiopod, crinoid, bryozoan and other skeletal debris; grain size 1.5 cm to less than .1 cm; bedding thick.

7 Biomicrite; color, unweathered - light olive gray (5Y6/1); weathered - yellowish gray (5Y8/1) to light olive gray (5Y6/1); matrix 55-65%, grains 35-45%; grains brachiopod (Mucrospirifer) shells and finer skeletal debris; grain size 1.5 cm to less than .1 cm, most grains less than .1 cm; bedding thick.

6 Biomicrite; color, unweathered - dark yellowish brown (10YR4/2), weathered - yellowish gray (5Y8/1); grains 55-65%, matrix 35-45%; grains mainly crinoid debris and spores; grain size .1 cm or less; bedding thin to medium with discontinuous gray shaley laminae; crinoid debris recrystallized.

5 Biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - yellowish gray (5Y8/1); matrix 35-45%, grains 55-65%; grains brachiopod, coral, crinoid and other skeletal debris; grain size maximum .5 cm, most less than .1 cm; bedding thick.

4 Biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - yellowish gray (5Y8/1); matrix 35-45%, grains 45-55%, pore space 0-5%; grains crinoid, brachiopod and other skeletal debris; grain size maximum .6 cm, most less than .1 cm; bedding thick with wavey brown laminae; stylolites present.

3 Dolomitic recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - yellowish gray (5Y8/1); cement 35-45%, grains 55-65%, pore space 0-5%; grains brachiopod, crinoid and other skeletal debris plus spores; grain size 1 cm to less than .1 cm; bedding thick with some thin brown laminae; dolomite rhombs.

2 <u>Dolomitic recrystallized limestone</u>; color, unweathered - pale yellowish brown (10YR6/2), weathered - yellowish gray (5Y8/1); cement 40-50%, grains 50-60%, pore space 0-5%; grains brachiopod, crinoid, and other skeletal debris plus spores; grain size less than .1 cm, bedding thick; dolomite rhombs.

1 <u>Dolomitic recrystallized limestone</u>; color, unweathered - pale yellowish brown (10YR6/2), weathered - grayish orange (10YR7/4); cement 35-40%, grains 50-60%, pore space 0-5%; grains crinoid, brachiopod and other skeletal debris plus spores; grain size .1 cm or less; bedding thick; dolomite rhombs.

0 <u>Dolomitic recrystallized limestone</u>; color, unweathered - pale yellowish brown (10YR6/2), weathered - yellowish gray (5Y8/1); cement 40-50%, grains 50-60%, grains corals, crinoids and other skeletal debris plus spores; grain size 2 cm maximum, most less than .1 cm; bedding thick. dolomite rhombs.

Locality 85792 - West of the Bridge at Port Albert

# Feet Above Base	Description of Lithology
13	Recrystallized limestone; color, unweathered - olive gray (5Y4/1) to dark yellowish brown (10YR4/2), weathered yellowish gray (5Y8/1); cement 40-50%, grains 50-60%; grains crinoid ossicles, bryozoan, brachiopod and other skeletal fragments plus spores; grain size .5 cm maximum, generally less than .1 cm; bedding thick; dolomite rhombs.
12	Recrystallized limestone; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); cement 75-85%, grains 15-25%, pore space 0-5%; grains spores plus shell debris; grain size less than .1 cm; bedding thick with some discontinuous black laminae; spores crushed parallel to bedding.
11	Recrystallized limestone; color, unweathered - dark yellowish brown (10YR4/2), weathered - light olive gray (5Y6/2); cement 20-30%, grains 60-70%, pore space 0-5%, grains primarily crinoid fragments with brachiopod skeletal debris and spores; grain size maximum .7 cm, most under .1 cm; bedding thick; silicification in fossils and as a replacement of spar.
10	Recrystallized limestone; color, unweathered - light olive gray (5Y6/1), weathered - light gray (N7); cement 65-75%, grains 25-35%, pore space 0-5%, grains crinoid and shell debris plus spores; grain size .1 cm or less; bedding thick; dolomite rhombs.
9	Recrystallized limestone; color, unweathered - light olive gray (5Y6/1), weathered - light gray (N7); cement 65-75%, grains 15-25%, pore space 5-10%; grains crinoid, brachiopod and other skeletal debris plus spores; grain size .2 cm maximum, most less than .1 cm; bedding thick.
8	Recrystallized limestone; color, unweathered - light olive gray (5Y6/1), weathered - light gray (N7), cement 80-90%, grains 10-20%, pore space 0-5%; grains crinoid, brachiopod and other skeletal debris plus spores; grain size maximum .4 cm, most less than .1 cm; bedding thick; dolomite rhombs.
7	Recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - yellowish gray (5Y8/1); cement 40-50%, grains 50-60%; pore space 0-5%; grains crinoid debris and spores; grain size .1 cm or less; bedding thick with some gray, discontinuous laminae.

6 <u>Recrystallized</u> <u>limestone</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); cement 40-50%, grains 50-60%, pore space 0-5%; grains primarily crinoid fragments with some brachiopod and other skeletal debris; grain size maximum .5 cm, most less than .1 cm; bedding thick with some wavey discontinuous gray laminae.

5 <u>Recrystallized</u> <u>limestone</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); cement 60-70%, grains 10-20%, pore space 5-15%; grains crinoid ossicles and whole or partial brachiopod shells; grain size more than 1 cm to .2 cm or less; bedding thick; some recrystallization of fragments; dolomite rhombs.

4 <u>Recrystallized</u> <u>limestone</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); cement 80-90%; grains 10-20%, pore space up to 10%; grains brachiopod, crinoid, and other skeletal debris; bedding thick with some shaley laminae weakly developed; dolomite rhombs.

3 <u>Recrystallized</u> <u>limestone</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); cement 80-90%, grains 5-15%, pore space 0-5%; grains crinoid and other skeletal debris and spores; grain size less than .1 cm; bedding medium with some light gray thick shaley laminae; dolomite rhombs.

2 <u>Recrystallized</u> <u>limestone</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); cement 40-50%, grains 50-60%, pore space 0-10%; grains crinoid ossicles and skeletal debris, grain size .1 cm or less; bedding thick.

1 <u>Recrystallized</u> <u>limestone</u>; color, unweathered - light olive gray (5Y6/1); weathered - light gray (N7); cement 80-90%, grains 5-15%, pore space 0-5%; grains skeletal debris; grain size less than .1 cm; bedding medium with shaley partings at top and bottom; dolomite rhombs.

0 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - dark yellowish brown (10YR4/2), weathered - very light gray (N8); matrix 30-40%, cement 10-20%, grains 40-50%; grains crinoid ossicles and skeletal debris; grain size .2 cm or less; bedding massive; stylolites present.

Locality 85793 - Pipers Dam just East of Goderich on South Side

Maitland River

# Feet Above Base	Description of Lithology
31	Biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); matrix 30-40%, grains 40-50%, grains 10-20%; grains undetermined skeletal debris; grain size .1 cm or less; bedding 1.8 cm.
30	Biomicrite; color, unweathered - dark yellowish brown (10YR4/2), weathered - moderate yellowish brown (10YR5/4); matrix 80-90%, grains 10-20%; grains brachiopod valve fragments and crinoid ossicles, grain size .7 cm or less; bedding thick.
29	Biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); matrix 50-60%, grains 10-20%, grains 20-30%, pore space 0-10%; grains crinoid, coral, and brachiopod skeletal debris; grain size 1 cm to less than .1 cm; bedding thick; stylolite present.
28	Recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 70-80%, grains 20-30%, pore space 0-5%; grains complete brachiopod shells, crinoid ossicles; grain size 1.3 cm or less; bedding 6 cm.
27	Recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 50-60%, grains 40-50%, pore space 0-10%; grains brachiopod and crinoid skeletal grains; grain size 1.4 cm or less; bedding 4.3 cm.
26	Recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 45-55%, grains 45-55%, pore space 0-5%; grains crinoid and brachiopod skeletal debris; grain size 1.7 cm to less than .1 cm, coarser grained at top; bedding 6 cm.
25	Crinoidal recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate brown (5YR4/4); cement 35-45%, grains 55-65%; grains crinoid, bryozoan, and shell fragments plus some spores; grain size .4 cm to less than .1 cm; bedding 5.5 cm with some discontinuous thin black laminae.

24 <u>Recrystallized limestone</u>; color, unweathered - pale yellowish brown (10YR6/2), weathered - grayish orange (10YR7/4); cement 60-70%, grains 30-40%, pore space 0-5%; grains crinoid, shell and crushed spore debris; grain size .7 cm or less; bedding 6 cm with some discontinuous black laminae.

23 <u>Recrystallized limestone</u>; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 55-65%, grains 35-45%, pore space 0-5%; grains crinoid, shell and spore debris; grain size .7 cm or less; bedding thick.

22 <u>Recrystallized limestone</u>; color, unweathered - very pale orange (10YR9/2) to pale yellowish brown (10YR5/4), weathered - grayish orange (10YR7/4); cement 80-90%, grains 10-20%, grains shell, spore and other skeletal debris; grain size .2 cm or less; bedding thick.

21.5 <u>Biomicrite</u>; color, unweathered - pale yellowish brown (10YR6/2), weathered - dark yellowish brown (10YR4/2); matrix 55-65%, grains 35-45%; grains coral, crinoid brachiopod (<u>Spinatrypa</u>) and other skeletal debris; grain size 1.5 cm or less; bedding medium.

21 <u>Recrystallized limestone</u>; color, unweathered - grayish orange (10YR7/4), weathered - moderate yellowish brown (10YR5/4); cement 40-50%, grains 50-60%, pore space 0-5%; grains shell and crinoid debris; grain size .4 cm to less than .1 cm; bedding thick.

20 <u>Recrystallized limestone</u>; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 80-90%, grains 10-20%, grains skeletal debris and spores; grain size .3 cm or less; bedding 4.5 cm.

19.5 <u>Recrystallized limestone</u>; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 85-95%, grains 5-15%; grains crinoid and shell debris plus spores; grain size 1.5 cm or less; bedding 5.4 cm.

19 <u>Recrystallized limestone</u>; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 75-85%, grains 15-25%; grains crinoid, shell, and spore debris; grain size .3 cm or less; bedding 4 cm.

18 <u>Crinoidal recrystallized limestone</u>; color, unweathered - grayish orange (10YR7/4), weathered - dark yellowish orange (10YR6/6); cement 55-65%, grains 35-45%; grains primarily crinoid ossicles, some brachiopod and gastropod fragments plus a few spores; grain size .3 cm or less; bedding 4 cm.

17 Crinoidal Recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - dark yellowish brown (10YR4/2); cement 60-70%, grains 30-40%; grains crinoid ossicles plus skeletal debris and spores; grain size 1 cm to less than .1 cm; fossil fragments elongate parallel to bedding; bedding 2 cm with discontinuous wavey dark laminae; stylolite present.

16 Recrystallized limestone; color, unweathered - very pale orange (10YR8/2), weathered - pale yellowish brown (10YR6/2); cement 85-95%, grains 5-15%; grains undetermined skeletal debris; grain size less than .1 cm; bedding 4 cm.

15 Dolomitic recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 60-70%, grains 30-40%; grains brachiopod and other skeletal debris plus spores; grain size .2 cm or less; bedding 3 cm with some thin, clayey laminae; dolomite rhombs.

14 Dolomitic spore recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - pale yellowish brown (10YR6/2); cement 65-75%, grains 25-35%; grains shell and crinoid debris plus spores; grain size .2 cm or less; bedding 6.5 cm, spores outline laminae; dolomite rhombs.

13 Dolomitic recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - dark yellowish brown (10YR4/2); cement 65-75%, grains 25-35%; grains crinoid and shell debris plus spores; grain size .2 cm or less; bedding 6 cm with laminae outlined by spores; dolomite rhombs.

12 Dolomitic recrystallized limestone; color, unweathered - light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); cement 85-95%, grains 5-15%; grains shell and other skeletal debris; grain size less than .1 cm; bedding 2.2 cm; dolomite rhombs.

11 Dolomitic recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - dark yellowish brown (10YR4/2); cement 85-95%, grains 5-15%; grains crinoid and brachiopod skeletal debris plus spores; grain size less than .1 cm bedding 7 cm +; dolomite rhombs.

10 Dolomitic recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - light olive gray (5Y6/1); cement 85-95%, grains 5-15%; grains crinoid ossicles and spores; grain size 1 cm or less; bedding 5 cm with some wavey black, thin laminae; dolomite rhombs.

9 Dolomitic recrystallized limestone; color, unweathered - light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); cement 85-95%, grains 5-15%; grains spores and unidentified skeletal debris; grain size less than .1 cm; bedding 5 cm; dolomite rhombs.

8 Dolomitic recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - light olive gray (5Y6/1); cement 85-95%, grains 5-15%; grains spores and minor skeletal debris; grain size less than .1 cm; bedding 3.3 cm; dolomite rhombs.

7 Dolomitic recrystallized limestone; color, unweathered - light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); cement 85-95%, grains 5-15%, grains shell and crinoid debris minor plus spores; grain size .5 cm to less than .1 cm; bedding 5 cm +; dolomite rhombs.

6 Dolomitic crinoid recrystallized limestone; color, unweathered light olive gray (5Y6/1), weathered - olive gray (5Y4/1); cement 30-40%, grains 60-70%; grains crinoid ossicles; grain size .2 cm or less; bedding 2 cm; dolomite rhombs.

5.5 Dolomitic crinoid recrystallized limestone; color, unweathered light gray (N7), weathered - moderate yellowish brown (10YR5/4); cement 50-60%, grains 40-50%, pore space 0-5%; grains primarily crinoid ossicles; grain size .3 cm or less; bedding 1.7 cm; stylolites present; dolomite rhombs.

5 Dolomitic recrystallized limestone; color, unweathered - light olive gray (5Y6/1), weathered - dark yellowish brown (10YR4/2); matrix 70-80%, grains 20-30%; grains, quartz sand, brachiopod crinoid and spore debris; grain size .8 cm or less; bedding 5.5 cm with stylolites; dolomite rhombs.

4 Dolomitic recrystallized limestone; color, unweathered - dark yellowish brown (10YR4/2), weathered - light olive gray (5Y6/1); cement 30-40%, grains 60-70%, pore space 0-5%; grains, quartz sand, shell fragments; grain size .4 cm or less; bedding 3 cm; dolomite rhombs.

3 Intramicrite; color, unweathered - clasts, pale yellowish orange (10YR8/6), brownish gray (5Y4/1), light olive gray (5Y6/1), weathered - moderate yellowish brown (10YR5/4); matrix 10-20%, grains 80-90%; grains intraclasts-quartz sand and large clasts, crinoid ossicles; grain size 2 cm to less than .1 cm; bedding 6.5 cm with some sandy laminae.

2 Micrite; color, unweathered - dark yellowish brown (10YR6/2), weathered - pale yellowish brown (10YR8/2); matrix 90-100%, grains 0-10%; grains quartz sand; grain size .2 cm or less; bedding 2.5 cm, stylolites present.

1 <u>Quartzose</u> <u>intramicrite</u>; color, unweathered - very pale orange (10YR8/2), weathered - pale yellowish brown (10YR6/2); matrix 5-10%, cement 5-10%, grains 70-80%, pore space 0-5%; grains large intraclasts and quartz sand grains, some sand in clasts; grain size 6 cm to .1 cm; bedding 10 cm.

0* <u>Quartzose</u> <u>intramicrite</u>; color, unweathered - matrix, pale yellowish brown (10YR6/2), clasts, grayish orange (10YR7/4); weathered - yellowish gray (5Y7/2); matrix 15-25%, grains 70-80%; grains intraclasts, quartz sand, a few crinoid ossicles; grain size 2.9 cm or less; bedding poorly developed and massive.

Locality 85794 - Falls of the Maitland River

# Feet Above Base	Description of Lithology
13	Recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 85-95%, grains 5-15%, grains crinoid and brachiopod debris; grain size .5 cm or less; bedding medium with thin partings at top; beekite present; dolomite rhombs.
12	Recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - pale yellowish brown (10YR6/2); cement 65-75%, grains 25-35%; grains coral, crinoid and brachiopod debris; grain size .9 cm or less; bedding 4 cm; some silicification of fossils and cement.
11	Recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - grayish orange (10YR7/4); cement 55-65%; grains 35-45%; grains brachiopod and crinoid skeletal debris; grain size 1.5 cm or less; bedding 6 cm; some silicification of fossils and cement.
10	Recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered grayish orange (10YR7/4); cement 85-95%, grains 5-15%; grains crinoid and other skeletal debris; grain size .1 cm or less; bedding thick.
9	Recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 50-60%, grains 40-50%; grains crinoid and other skeletal debris; grain size .5 cm or less; bedding 3 cm; partial silicification of fossils.
8	Dolomitic recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered grayish orange (10YR7/4); cement 85-95%, grains 5-15%; grains crinoid and shell fragments plus spores; grain size .7 cm or less; bedding 6.3 cm; partial silicification of fossils; dolomite rhombs.
7	Dolomitic recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 85-95%, grains 5-15%; grains crinoid and shell debris plus spores; grain size .4 cm or less; bedding thick with some carbonaceous laminae; dolomite rhombs.
6	Dolomitic recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 60-70%, grains 30-40%; grains crinoid debris and spores; grain size .1 cm or less; bedding thick with spores crushed subparallel to bedding; dolomite rhombs.

5 Dolomitic recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 85-95%, grains 5-15%; grains crinoid debris and spores; grain size .5 cm or less; bedding thick; spores subparallel to bedding; dolomite rhombs.

4 Dolomitic recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 50-60%, grains 40-50%; grains crinoid debris; grain size .2 cm or less; bedding massive with thin carbonaceous laminae; dolomite rhombs.

3 Dolomitic recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); cement 75-85%, grains 25-35%; grains crinoid and brachiopod debris; grain size .6 cm or less; bedding massive with thin shaley laminae; dolomite rhombs.

2 Crinoidal recrystallized limestone; color unweathered - pale yellowish brown (10YR6/2), weathered - dark yellowish brown (10YR4/2); cement 40-50%, grains 50-60%, pore space 0-5%; grains primarily crinoid ossicles, some brachiopod shell fragments; grain size .3 cm or less; bedding 4.6 cm; pyrite present; solomite rhombs.

1 Crinoidal recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - dark yellowish brown (10YR4/2); cement 85-95%, grains 5-15%; grains crinoid ossicles and spores; grain size less than .1 cm; bedding thick; dolomite rhombs.

0 Chert; color, unweathered - pale yellowish brown (10YR6/2), weathered - grayish orange (10YR7/4); spores present.

Locality 85795 - Along the Maitland River at Benmiller on North Side,

100 Yards West of Bridge Across Maitland River

# Feet Above Base	Description of Lithology
10	Biomicrite; color, unweathered - brownish gray (5YR4/1), weathered - yellowish gray (5Y8/1); matrix 80-90%, grains 10-20%; grains brachiopod valves and crinoid ossicles; grain size .5 cm to less than .1 cm; bedding thick; partial silicification of shell fragments; dolomite rhombs.
9	Biomicrite; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y8/1), weathered - yellowish gray (5Y8/1); matrix 80-90%, grains 10-20%; grains brachiopod, crinoid and other skeletal grains; grain size 1.3 cm to less than .1 cm; bedding thick; silicification of parts of shells; partial recrystallization of crinoid ossicles; dolomite rhombs.
8	Biomicrite; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 65-75%, cement 55-65%, grains 25-35%; grains coral, brachiopod and other skeletal fragments; grain size 1.5 cm to less than .1 cm; bedding thick; partial silicification of fossils; dolomite rhombs.
7	Biomicrite; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 50-60%, cement 10-20%, grains 25-35%; grains partial brachiopod shells, crinoid ossicles and skeletal debris; grain size 2 cm to .1 cm, most less than .2 cm; bedding thick with thin shaley laminae weakly developed; stylolite present; partial silicification of fossils; dolomite rhombs.
6	Recrystallized limestone; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 20-30%, cement 30-40%, grains 30-40%; grains bryozoan and crinoid debris; grain size 1.5 cm to .1 cm or less, most grains less than .1 cm; bedding thick; replacement of fossils and cement with silica; dolomite rhombs.
5	Recrystallized limestone; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 5-10%, cement 45-55%, grains 35-45%, pore space 0-5%; grains bryozoan, crinoid, brachiopod, and undetermined skeletal fragments; grain size 1.5 cm to less than .1 cm; bedding medium; partial silicification of fossils; dolomite rhombs.

4 <u>Recrystallized</u> <u>limestone</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); cement 45-55%, grains 35-45%, pore space 0-10%; grains brachiopod valves whole and partial and crinoid debris; grain size 2 cm to less than .1 cm; bedding thick; fossils partially silicified; dolomite rhombs.

3 <u>Recrystallized</u> <u>limestone</u>; color, unweathered - light olive gray (5Y6/1), weathered yellowish gray (5Y8/1); cement 45-55%, grains 45-55%; grains brachiopod, crinoid and other skeletal debris; grain size 1 cm to less than .1 cm; bedding thick; partial silicification of fossils; dolomite rhombs.

2 <u>Recrystallized</u> <u>limestone</u>; color, unweathered - pale yellowish brown (10YR6/2), weathered - yellowish gray (5Y8/1); matrix 50-60%, cement 60-70%, grains 30-40%; grains brachiopod and crinoid skeletal debris; grain size .7 cm to less than .1 cm; bedding medium; dolomite rhombs.

1 <u>Recrystallized</u> <u>limestone</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); cement 60-70%, grains 30-40%; grains crinoid, coral, brachiopod, and other skeletal debris; grain size 5 cm to less than .1 cm; bedding medium with some wavey discontinuous thin black laminae; stylolites present; partial silicification of fossils; dolomite rhombs.

0 <u>Recrystallized</u> <u>limestone</u>; color, unweathered - light olive gray (5Y6/1), weathered - light olive gray (5Y6/1) to yellowish gray (5Y8/1); cement 80-90%, grains 10-20%; grains skeletal debris; grain size .2 cm or less; bedding medium; dolomite rhombs.

Locality 85796 - Along the South Bank of the Maitland River at Goderich

# Feet Above Base	Description of Lithology
4	Recrystallized limestone; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); cement 25-35%, grains 65-75%, pore space 0-5%; grains brachiopod valves and skeletal debris plus spores; grain size 1 cm to .1 cm or less; bedding thick; dolomite present.
3	Covered
2	Micrite; color, unweathered - pale yellowish brown (10YR6/1), weathered - yellowish gray (5Y8/1); matrix 100%; well sorted, fine-grained; bedding medium, stylolites present.
1	Micrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - yellowish gray (5Y8/1); matrix 100%; well sorted, fine-grained; bedding medium; stylolites present.
0*	Rounded, packed intramicrite; color, unweathered - yellowish gray (5Y8/1) to light olive gray (5Y6/1), weathered - light olive gray (5Y6/1); matrix 25-35%, cement 5-15%, grains 55-65%, pore space 0-5%; grains micritic intraclasts and less than 5% fossils (brachiopod shells and spores); grain size 3 cm to less than .1 cm; grains round to sub-round, poorly sorted; bedding medium; stylolites present.

Locality 85797 - Beneath the Bridge at Brussels

# Feet Above Base	Description of Lithology
4	Biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); matrix 35-45%; grains 55-65%, pore space 0-10%; grains crinoid and other skeletal debris; grain size .4 cm or less; bedding 5 cm; beekite present.
3	Biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); matrix 20-30%, cement 10-20%, grains 50-60%, pore space 0-5%; grains coral, brachiopod crinoid and other skeletal debris plus spores; grain size .2 cm or less; bedding thick; shell fragments pratly silicified.
2	Biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - pale yellowish brown (10YR6/2); matrix 70-80%; grains 10-20%; pore space 0-10%; grains skeletal fragments; grain size .2 cm or less; bedding 4 cm.
1	Coral recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - dark yellowish orange (10YR6/6); cement 30-40%, grains 50-60%, pore space 0-10%; grains primarily corals with crinoid and shell debris plus spores; grain size 2.0 cm or less; bedding 6 cm; stylolites present; some corals partially silicified.
0	Recrystallized limestone; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate yellowish brown (10YR5/4); matrix 60-70%, grains 30-40%, pore space 0-5%; grains crinoid and brachiopod skeletal debris plus spores; grain size .3 cm or less; bedding 2-3 cm; beekite present.

Locality 85798 - 3 Miles North of St. Mary's Along Thames River

# Feet Above Base	Description of Lithology
9	Biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); cement 30-40%, grains 55-65%; grains brachiopod shells whole and partial, coral and crinoid debris; grain size 1.5 cm to less than .1 cm; bedding medium; dolomite rhombs present.
8	Crinoid biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - yellowish gray (5Y8/1); matrix 30-40%, grains 60-70%; grains primarily crinoid ossides with some brachiopod and trilobite debris; grain size 2 cm to .1 cm; bedding medium to thick.
7	Crinoid biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - yellowish gray (5Y8/1); matrix 30-40%, grains 60-70%; grains primarily crinoid ossides with brachiopod shells and coral debris; grain size 2.6 cm to less than .1 cm; bedding medium.
6	Biomicrite; color, unweathered - pale yellowish brown (10YR6/2); weathered - yellowish gray (5Y8/1); matrix 30-40%, grains 60-70%; grains crinoid, brachiopod, coral, and bryozoan debris with some spores; grain size 2 cm to less than .1 cm; shells elongate parallel to bedding; bedding thick with poorly developed dark laminae; some shell replaced by pyrite.
5	Biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - yellowish gray (5Y8/1); matrix 30-40%, grains 60-70%; grains primarily crinoid and shell debris, some whole brachiopod shells; grain size 2.5 cm to less than .1 cm; bedding thick minor silica and pyrite replacement of shell.
4.5	Biolithite; color, unweathered - moderate yellowish brown (10YR5/4), weathered - pale yellowish orange (10YR8/6), matrix 25-35%, cement 5-15%, grains 55-65%; grains whole corals, brachiopod, coral, bryozoan, and crinoid fragments with a few spores; grain size 4 cm to less than .1 cm; bedding thin to medium; silica replacement of some skeletons.
4	Biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 30-40%, cement 10-20%, grains 50-60%; grains crinoid, brachiopod, bryozoan, gastropod and unidentified debris plus spores; grain size 1.5 cm or more to less than .1 cm; bedding thin to medium.

3 Biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 25-35%; grains 75-85%; grains crinoid and unidentified fragments plus spores; grain size .2 cm to less than .1 cm; bedding thick; some minor silicification in fossil fragments.

2 Biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y7/2); matrix 40-50%; grains 50-60%; grains crinoid, coral, and brachiopod skeletal fragments plus spores; grain size 1.3 cm to less than .1 cm; bedding thick, silica in masses and replacing coral skeletons.

1 Biomicrite; color, unweathered - light olive gray (5Y6/1), weathered yellowish gray (5Y8/1); matrix 45-55%, grains 45-55%; grains coral, crinoid, brachiopod and determined skeletal debris plus spores; grain size .5 cm to less than .1 cm; bedding thin to medium; partial silicification of some fossils.

0 Coral biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 25-35%, cement 10-20%, grains 60-70%; grains corals with crinoid ossicles and brachiopod fragments; grain size greater than 1.5 cm to less than .1 cm; bedding medium; silicification of some fossils.

Locality 85799 - 2 Miles North of St. Mary's Along Thames River

# Feet Above Base	Description of Lithology
2	Brachiopod biomicrite; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 80-90%, grains 10-20%; grains brachiopod valves whole and partial and one crinoid ossicle; grain size .6 cm or less; bedding medium; brachiopod valves generally convex down; pyrite replacement of some shell.
1	Burrowed biomicrite; color, unweathered - olive gray (5Y4/1) to light olive gray (5Y6/1), weathered - very pale orange (10YR8/2); matrix 85-95%, grains 5-15%, grains crinoid fragments, brachiopod valves whole and partial; grain size .3 cm to less than .1 cm; bedding medium, disrupted.
0	Brachiopod biomicrite; color, unweathered - olive gray (5Y4/1), weathered - yellowish gray (5Y8/1); matrix 85-95%, grains 5-15%; grains brachiopod whole single valves and pieces plus a few crinoid ossicles; grain size 1 cm to less than .1 cm; bedding medium with some discontinuous brown laminae; pyrite replaces portions of shells.

Locality 85800 - At Top of West Side of Quarry in Northeast

Part of St. Mary's - Now a Dump

# Feet Above Base	Description of Lithology
3	Biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - pale yellowish brown (10YR6/2); matrix 35-45%, grains 55-65%; grains coral, crinoid and other skeletal debris plus spores; grain size 1 cm or less; bedding thick.
2	Biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - pale yellowish brown (10YR6/2); matrix 55-65%; grains 35-45%; grains skeletal fragments and spores; grain size less than .1 cm; bedding thick.
1	Biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - pale yellowish brown (10YR6/2); matrix 55-65%, grains 35-45%; grains brachiopod, crinoid, bryozoan and spore material; grain size .4 cm or less; bedding thick.
.5	Crinoid biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - dark yellowish brown (10YR4/2); matrix 45-55%, grains 45-55%; grains primarily crinoid ossicles with coral, brachiopod and other skeletal debris and spores; grain size .2 cm; bedding 3 cm; coarser debris at base.
0*	Crinoid biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - moderate reddish brown (10R4/6); matrix 35-45%, grains 55-65%; grains primarily crinoid debris with skeletal fragments; grains less than .1 cm; bedding 5.8 cm; rock greatly weathered.

Locality 85801 - St. Mary's Cement Co. Old Quarry - East Side of Thames River - South of Main Plant - Samples Taken Along North Central Face

# Feet Above Base	Description of Lithology
44	Burrowed biomicrite; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 75-85%, grains 15-25%; grains primarily brachiopod shells (some complete), and a few crinoid ossicles; grain size 1.5 cm or less; brachiopod valves concave - up or - down; much evidence of burrowing; bedding thick, massive; some pyrite replacement of fossils.
43	Argillaceous brachiopod biomicrite; color, unweathered - dark yellowish brown (10YR4/2), weathered - light brownish gray (5YR6/1); matrix 60-70%, cement 10%, grains 30-40%; grains intact brachiopods and a few crinoid ossicles; grain size 1 cm or less, shells subparallel to shaley laminae; bedding thin with wavey shaley partings; spar fills interior of many shells.
42	Biomicrite; color, unweathered - olive gray (5Y4/1), weathered-light olive gray (5Y6/1); matrix 85-95%, grains 5-15%; grains partial brachiopod valves and some gastropod shell fragment; sorting poor; bedding massive.
41	Argillaceous brachiopod biomicrite; color, unweathered - olive gray (5Y4/1), weathered - yellowish gray (5Y8/1); matrix 65-75%; cement 5-10%, grains 25-35%; grains brachiopod shells single valves, both valves, and partial, gastropod shells; grain size 1.0-0.5 cm, concentrated in layers parallel to bedding; sorting poor; bedding thin with some brown shaley laminae; some pyrite present.
40	Brachiopod biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - light olive gray (5Y6/1) to olive gray (5Y4/1); matrix 70-80%, cement 5-10%, grains 15-25%; grains primarily brachiopod shells with some crinoid debris; grain size .5 cm or less, shells parallel or perpendicular to bedding, shells mostly convex valves; bedding massive; pyrite sometimes replaces calcite, valves in whole shells filled with spar.
39	Burrowed biomicrite; color, unweathered - light olive gray (5Y6/1); weathered - yellowish gray (5Y8/1); matrix 55-65%, grains 35-45%; grains primarily brachiopod shells with some crinoid ossicles; grain size from more than 1 cm to less than .1 cm; bedding medium with burrowing and disruption; some pyrite present as secondary fillings.

38 <u>Brachiopod</u> <u>biomicrite</u>; color, unweathered - olive gray (5Y4/1), weathered - medium light gray (N6) to light gray (N7); matrix 55-65%, cement 5-10%, grains 35-45%; grains primarily single and fragmental brachiopod shells, some crinoid ossicles and coral fragments; grain size 1.0 to 0.5 cm shells parallel or sometimes perpendicular to bedding; medium with some shaley wavey laminae; calcite filling of shells present.

37 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 35-45%, cement 5-10%; grains 50-60%; grains primarily crinoid debris with some brachiopod shell; grain size 1 cm or less, shells subparallel to beds and broken; bedding massive with some shaley laminations; calcite fills shell.

36 <u>Burrowed</u> <u>biomicrite</u>; color, unweathered - olive gray (5Y4/1) to light olive gray (5Y6/1), weathered - light olive gray (5Y6/1); matrix 55-65%, cement 5-10%, grains 35-45%, pore space less than 5%; grains mostly brachiopod shells with some crinoid ossicles; grain size .7 cm or less, shells subparallel to beds; bedding massive with poorly developed stratification, burrowing common; pyrite replaces shell material at times, calcite fills shell.

35 <u>Biomicrite</u>; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 25-35%, grains 65-75%; grains crinoid ossicles and brachiopod shells; grain size .5 cm or less, bedding massive with discontinuous black laminae; some pyrite present as scattered irregular masses.

34 <u>Burrowed</u> <u>biomicrite</u>; color unweathered - burrows - brownish gray (5YR4/1), matrix light olive gray (5Y6/1), weathered - yellowish gray (5Y7/1); matrix 30-40%, grains 60-70%; grains fragmental brachiopod shells; grains .1 cm or less; bedding massive with thin black shaley laminae at base; pyrite replaces some shell fragments partially, calcite shell filling.

33 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 10-20%, grains 80-90%; grains crinoid ossicles with some intact brachiopod shells; grain size .5 cm or less; bedding massive with some black shaley laminae; scattered irregular pyrite masses.

32 <u>Burrowed</u> <u>biomicrite</u>; color, unweathered - olive gray (5Y4/1), weathered - light gray (N7); matrix 80-90%, grains 10-20%, grains crinoid ossicles and small brachiopod shells; grain size .2 cm or less; bedding thick; some scattered pyrite.

31 <u>Crinoid biomicrite</u>; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 20-30%, grains 70-80%; grains primarily crinoid ossicles with some brachiopod and shell debris; grain size .5 cm or less, bedding thick with some discontinuous shaley laminae.

30 <u>Crinoid biomicrite</u>; color, unweathered - olive gray (5Y4/1), to light olive gray (5Y6/1); weathered - grayish orange (10YR7/4); matrix 20-30%, cement 5-10%, grains 55-65%; grains crinoid ossicles and undetermined fragments; grain size .5 cm or less; bedding massive.

29 <u>Crinoid biomicrite</u>; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 15-25%, cement 5-10%, grains 75-85%; grains primarily crinoid ossicles with some brachiopod shells, one gastropod shell and many undetermined fragments; grain size .7 cm or less; bedding thick, massive; some irregular pyrite masses present.

28 <u>Crinoid biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 40-50%, grains 50-60%; grains primarily crinoid ossicles with a few brachiopod and coral fragments; grain size .4 cm or less; bedding thick, massive, some crinoid ossicles recrystallized.

27.8 <u>Crinoid biomicrite</u>; color, unweathered - olive gray (5Y4/1) to light olive gray (5Y6/1), weathered - light olive gray (5Y6/1); matrix 25-35%, grains 65-75%; grains primarily crinoid ossicles and a few brachiopod shells; grain size .5 cm or less; bedding thick, massive.

27 <u>Crinoid biomicrite</u>; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 15-25%, grains 75-85%; grains mostly crinoid ossicles with some bryozoan fragments; grain size .3 cm or less; bedding medium with some black laminae; ossicles recrystallized, stylolites present.

26 <u>Crinoid biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - light gray (N7); matrix 15-25%, grains 75-85%; grains primarily crinoid ossicles with some brachiopod and coral fragments; grain size .2 cm or less; bedding thick; some crinoid ossicles recrystallized.

25 <u>Crinoid biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y7/2); matrix 25-35%, grains 65-75%; grains primarily crinoid fragments with some bryozoans and brachiopod fragments; grain size .5 cm or less; bedding thick.

24 <u>Biomicrite</u>; color, unweathered - olive gray (5Y4/1), weathered - medium light gray (N6); matrix 15-25%, grains 75-85%; grains primarily undetermined with some crinoid and bryozoan fragments; grain size .5 cm but generally less than .1 cm; bedding thick, massive; some recrystallization of crinoid ossicles.

23 <u>Crinoid biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - light gray (N7); matrix 15-25%, grains 75-85%; grains crinoid ossicles; grain size .2 cm or less; bedding thick with a few brown shaley partings.

22 <u>Crinoid biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y7/2); matrix 15-25%, grains 75-85% grains crinoid ossicles; grain size .7 cm or less; bedding thick with thin dark laminae.

21 <u>Crinoid biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - very light gray (N8); matrix 45-55%. cement 5-10%, grains 45-55%; grains primarily crinoid ossicles with brachiopod shell fragments; grain size .5 cm with most less than .1 cm; bedding thick, massive.

20 <u>Crinoid biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - very light gray (N8), matrix 10-20%, grains 80-90%; grains primarily crinoid ossicles with some coral fragments; grain size greater than 1 cm to less than .1 cm; bedding thick, massive; crinoid debris partially recrystallized.

19 <u>Biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - light gray (N7); matrix 15-25%, grains 75-85%; grains crinoid ossicles, brachiopod shells and undetermined debris; grain size 1 cm, generally less than .2 cm; bedding thick with discontinuous shaley layers.

18 <u>Crinoid biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 20-30%, grains 60-70%; grains crinoid ossicles brachiopod valves and many small undetermined ossicles; train size .3 cm or less; bedding thick, massive.

17 <u>Biomicrite</u>; color, unweathered - olive gray (5Y4/1) to light olive gray (5Y6/1), weathered - light olive gray (5Y6/1); matrix 25-35%, cement 5-10%, grains 55-65%; grains brachiopod, crinoid and bryozoan debris; grain size .6 cm or less; bedding thick, massive with poorly developed wavey laminae.

16 <u>Biomicrite</u>; color, unweathered - olive gray (5Y4/1) to light olive gray (5Y6/1), weathered - light olive gray (5Y6/1); matrix 25-35%; cement 5-10%, grains 60-70%; grains brachiopod, bryozoan, coral and crinoid fragments; grain size 1.5 cm to .1 cm or less; bedding medium; calcite in coral and bryozoan interstices.

15 <u>Biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - very light gray (N8); matrix 15-25%, grains 75-85%; grains primarily brachiopod valve fragments with crinoid and bryozoan fragments; grain size .6 cm or less; bedding thick; some shell crushing.

14 <u>Biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 15-25%, grains 75-85%; grains single brachiopod valves and crinoid ossicles; grain size .7 cm or less.

13 <u>Biomicrite</u>; color, unweathered - olive gray (5Y4/1) to light olive gray (5Y6/1); matrix 15-25%, grains 75-85%; grains primarily undetermined fragments with brachiopod shells and a few crinoid ossicles, some intact large brachiopods; 1.4 cm or less; bedding thick, massive.

12 <u>Biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 30-40%; grains 60-70%; grains brachiopod, bryozoan, crinoid, coral and unidentified fragments; 2 cm to less than .1 cm, no orientation of grains; bedding thick, massive with some wavey, poorly developed partings.

11 <u>Packed crinoid coral biomicrite</u>; color, unweathered - light gray (N7), weathered - very light gray (N8); matrix 15-25%, cement 5-15%, grains 60-70%, pore space 5-15%; grains coral, bryozoan, trilobite, brachiopod and crinoid debris; grain size from more than 3 cm to less than .1 cm, fossils aligned in zones of coarser and finer material; bedding very thick, massive.

10 <u>Crinoid biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - light gray (N7); matrix 50-60%, grains 40-50%; grains crinoid debris with some brachiopod and bryozoan fragments; grain size .2 cm or less; bedding thick with some discontinuous dark laminae.

9 <u>Crinoid biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 20-30%, grains 70-80%; grains primarily crinoid ossicles with brachiopods and scolecodont fragments; grain size .5 cm or less; bedding thick.

8 <u>Biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 40-50%, grains 50-60%; grains undetermined debris; grain size .1 cm or less; bedding thick.

7 <u>Biomicrite</u>; color, unweathered - moderate yellowish brown (10YR5/4) to light brown (10YR7/4), weathered - moderate yellowish brown (10YR5/4); matrix 30-40%, cement 5-15%, grains 55-65%; grains bryozoan, and crinoid fragments and spores; grain size .7 cm or less; bedding thick; irregular masses of pyrite present; calcite replaces matrix in some places.

6 <u>Biomicrite</u>; color, unweathered - olive gray (5Y8/1), to light olive gray (5Y6/1), weathered - light olive gray (5Y6/1); matrix 40-50%; grains 50-60%; grains brachiopod and unidentified fragments; grain size .5 cm or less; bedding thick.

5 <u>Biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 35-45%, grains 55-65; grains mostly undetermined fragments but some brachiopods bryozoan, coral and crinoid debris plus spores; grain size .6 cm or less; bedding thick; scattered pyrite present.

4 <u>Biomicrite</u>; color, unweathered - light olive gray (5Y6/1); weathered - light olive gray (5Y6/1) to yellowish gray (5Y8/1); matrix 25-35%, cement 10-20%, grains 50-60%; grains primarily crinoid, shell, and unidentified debris plus spores; grain size .1 cm or less; bedding thick.

3 <u>Biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 20-30%, cement 5-15%, grains 60-70%; grains coral, brachiopod, and bryozoan fragments and spores; grain size more than 2 cm to less than .1 cm; bedding thick, massive; pyrite throughout.

2 <u>Biomicrite</u>; color, unweathered - olive gray (5Y4/1) to light olive gray (5Y6/1), weathered - light olive gray (5Y6/1); matrix 25-35%, cement 5-15%; grains 50-60%; grains unidentified fragments plus coral and brachiopod debris; grain size .9 cm or less; bedding thick; pyrite replaces some shell material.

1 <u>Biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 55-65%, cement 5-15%, grains 25-35%; grains brachiopods, bryozoan, crinoid, coral, trilobite and pelecypod shell; grain size 4 cm to less than .1 cm; bedding medium with black shaley partings.

0* <u>Packed</u> <u>intrasparite</u>; color, unweathered - clasts light gray (N7) to very light gray (N8), matrix olive gray (5Y4/1) to light olive gray (5Y4/1), weathered - yellowish gray (5Y8/1); matrix 0-10%, cement 20-30%, grains 60-70%, pore space 5-10%; grains intraclasts 80-90%, crinoid and unidentified debris 10-20%; grain size greater than 2.5 cm to less than .1 cm; bedding massive with intraclasts aligned with long axes parallel to bedding; irregular pyrite masses.

Locality 85802 - St. Mary's Cement Co. New Quarry - West Side

of Thames River - Collection Made Along

West Wall of Ramp

# Feet Above Base	Description of Lithology
41	Brachiopod biomicrite; color, weathered - medium gray (N7) to light moderate brown (5YR5/4), weathered - light olive gray (5Y6/1); matrix 80-90%, grains 10-20%; grains brachiopod shells whole and partial and crinoid debris; grains size .1 cm or less; bedding 2 cm laminations; pyrite crystals present.
40	Brachiopod biomicrite; color, unweathered - pale yellowish brown (10YR6/2) to light brown (5YR6/4), weathered - moderate yellowish brown (10YR5/4); matrix 70-80%, grains 20-30%; grains brachiopod shells whole and partial crinoid ossicles and unidentified debris; grain size .5 cm or less; bedding 4.5 cm or larger; pyrite replaces matrix.
39	Micrite; color, unweathered - light olive gray (5Y6/1), weathered - light olive gray (5Y6/1) to olive gray (5Y4/1); matrix 85-95%, grains 5-15%; grains undetermined shell debris; grain size less than .1 cm; bedding 5.2 cm with black argillaceous partings near top.
38	Burrowed biomicrite; color, unweathered - dark yellowish brown (10YR4/2), weathered - dark yellowish brown (10YR4/2); matrix 85-90%, grains 10-15%; grains shell and crinoid debris; grain size .1 cm or less; bedding 5 cm with disrupted laminae.
37	Burrowed biomicrite; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 90-95%; grains 5-10%; grains brachiopod valves partial; grain size .1 cm or less; bedding 7.5 cm with thin black laminae at top and bottom; many burrows; some purite replacement of matrix and shell.
36	Brachiopod biomicrite; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 80-90%, grains 10-20%; grains primarily brachiopod shells whole and partial; grain size 1.5 cm or less; bedding 4 cm; some evidence of burrowing; partial replacement of some shell material by pyrite.

35 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 50-60%, grains 40-50%; grains crinoid ossicles; grain size .2 cm; bedding 3.5 cm with some discontinuous black laminae on top.

34 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 20-30%, grains 70-80%; grains primarily crinoid ossicles with some shell fragments; grain size .2 cm or less; bedding 5 cm.

33 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 25-35%, grains 65-75%; grains primarily crinoid ossicles and shell debris; grain size .2 cm or less; bedding 4.3 cm; finer grained than 34.

32 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - pale yellowish brown (10YR6/2) to dark yellowish brown (10YR4/2), weathered - light olive gray (5Y6/1); matrix 75-85%, grains 15-25%; grains primarily crinoid ossicles with some shell fragments; grain size .7 cm but generally .1 cm or less; bedding massive.

31 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 30-40%, grains 60-70%; grains primarily crinoid ossicles with some brachiopod and undetermined fragments; grain size .8 cm or less; bedding 4.5 cm; some pyrite in irregular masses in groundmass.

30 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 30-40%, grains 60-70%; grains crinoid ossicles and bryozoan and brachiopod fragments; grain size .2 cm or less; bedding 5.6 cm with discontinuous black laminae at top and bottom; some pyrite replacement of shell material; stylolites present.

29 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 25-35%, grains 65-75%; grains primarily crinoid ossicles with some brachiopod shell fragments; grain size .3 cm or less; bedding 3.7 cm with discontinuous black laminae; some pyrite replacement of shell material; stylolites present.

28 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 30-40%, grains 60-70%; grains primarily crinoid ossicles and some shell debris; grain size .2 cm or less; bedding 4.5 cm; pyrite replacement of portion of shell fragment.

27 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 25-35%, grains 65-75%; grains crinoid ossicles and a few shell fragments; grain size .2 cm; bedding 5 cm with discontinuous black laminae throughout; some pyrite replacement of shell.

26 <u>Biomicrite</u>; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 70-80%, grains 20-30%; grains brachiopod and crinoid fragments; grain size 1 cm or less; bedding 2 cm with discontinuous black laminae at base and top.

25 <u>Biomicrite</u>; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 30-40%, grains 60-70%; grains coral, crinoid, and brachiopod fragments; grain size 1.7 cm or less; bedding 2.4 cm.

24 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - light olive gray (5Y6/1) to olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 30-40%, grains 60-70%; grains crinoid debris; grain size .5 cm or less, long axes of grains parallel to bedding; bedding 4 cm with some discontinuous black laminae.

23 <u>Biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - light olive gray (5Y6/1) to olive gray (5Y4/1); matrix 35% grains 65%; grains primarily brachiopod valves, some crinoid debris and unidentified debris,scolecodont fragment; grain size 1 cm or less; bedding massive; some burrowing of sediment.

22 <u>Biomicrite</u>; color, unweathered - medium gray (N5) to light olive gray (5Y6/1), weathered - light gray (N7); matrix 30-40%, grains 60-70%; grains brachiopod and crinoid debris; grain size .3 cm or less; bedding 7.5 cm with discontinuous black laminae at base.

21 <u>Biomicrite</u>; color, unweathered - light gray (N7) to light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); matrix 15-25%; grains 75-85%; grains crinoid, brachiopod (<u>Atrypa</u>) fragments; grain size .5 cm, generally much less; bedding 6 cm with some black laminae at top and base.

20 <u>Crinoid</u> <u>biomicrite</u>; color, unweathered - light olive gray (5Y6/1), weathered - light olive gray (5Y6/1); matrix 30-40%, grains 60-70%; grains crinoid ossicles and brachiopod fragments; grain size 2 cm or less; bedding 8 cm, massive.

19 Biostromal biosparite; color, unweathered - light gray (N7) to dark yellowish brown (10YR4/2), weathered - dark yellowish brown (10YR4/2); cement 35-45%, grains 45-55%, pore space 5%; grains coral, crinoid, bryozoan, brachiopod and undetermined fragments; grain size 2 cm, larger or smaller; sorting very poor; fragments disoriented; bedding 8 cm, massive; some pyrite present.

18 Biomicrite; color, unweathered - light gray (N7) to dark yellowish brown (10YR4/2), weathered - dark yellowish brown (10YR4/2); matrix 50-60%, grains 40-50%; grains primarily crinoid and brachiopod fragments; grain size .5 cm, usually less; bedding 6 cm with some wavey black laminae at top; specimen has mottled gray and brown appearance.

17 Crinoid biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); matrix 30-40%, grains 60-70%; grains predominately crinoid with coral and brachiopod (atrypid) fragments and whole shells; grain size 1.7 cm or less; bedding 10 cm.

16 Crinoid biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); matrix 35-45%, grains 55-65%; grains crinoid, bryozoan and brachiopod debris; grain size 1 cm or less; bedding 6.2 cm with some discontinuous black laminae at top and base.

15.6 Crinoid biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); matrix 35-45%, grains 55-65%; grains predominately crinoid ossicles with bryozoan, brachiopod and coral debris; grain size 1.4 cm or less; bedding 3.6 cm, irregular with black wavey laminae; some pyrite replaces fossil fragments; stylolites present.

15 Crinoid biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); matrix 35-45%, grains 55-65%; grains predominately crinoid debris with brachiopod, bryozoan, and gastropod fragments; grain size .7 cm or less; bedding 3 cm with numerous black wavey partings; some pyrite replacement of shell debris.

14 Biomicrite; color, unweathered - light gray (N7) to light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); matrix 40-50%, grains 50-60%; grains bryozoan, crinoid, brachiopod and coral fragments (*Mucrospirifer consobrinus* present); grain size .9 cm or less; bedding 8.5 cm, massive; some pyrite replaces fossil fragments.

13 Crinoid bromicrite; color, unweathered - light gray (N7) to light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); matrix 25-35%, grains 65-75%; grains primarily crinoid ossicles, a few spores; grain size .1 cm or less; bedding 2.2 cm.

12 Biomicrite; color, unweathered - light gray (N7) to light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); matrix 35-45%, grains 55-65%; grains spores, crinoid, shell and undetermined debris; grain size 1 cm or less; bedding 5 cm, massive; some irregular masses of pyrite.

11 Biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - light olive gray (5Y6/1); matrix 55-65%, grains 35-45%; grains coral, brachiopod and crinoid fragments, some whole and crushed spores; grain size .6 cm or less; sorting very poor; grains very fragmental; bedding 6 cm, massive.

10 Crinoid biomicrite; color, unweathered - light gray (N7) to light olive gray (5Y6/1); weathered - pale yellowish brown (10YR6/2); matrix 25-35%, grains 65-75%; grains crinoid, brachiopod, and bryozoan fragments; grain size .9 cm or less, sorting very poor; bedding 6.5 cm, massive; some pyrite replacement of brachiopod shells.

9 Biomicrite; color unweathered - light gray (N7) to light olive gray (5Y6/1); weathered - pale yellowish brown (10YR6/2); matrix 40-50%, grains 50-60%; grains brachiopod, crinoid and undetermined fragments plus spores; grain size .5 cm or less; bedding massive; some pyrite present.

8 Biomicrite; color, unweathered - light gray (N7) to light olive gray (5Y6/1); weathered - pale yellowish brown (10YR6/2); matrix 45-55%, grains 45-55%; grains crinoid, brachiopod and undetermined fragments plus spores; grain size .8 cm or less; bedding 4 cm with some discontinuous black laminations; partial silicification of some fossil fragments.

7 Biomicrite; color, unweathered - light gray (N7) to light olive gray (5Y6/1); weathered - pale yellowish brown (10YR6/2); matrix 45-55%, grains 45-55%; grains crinoid, bryozoan, and brachiopod fragments and some whole spores; grain size 1.5 cm or less; bedding massive.

6 Biomicrite; color, unweathered - light gray (N7) to light olive gray (5Y6/1); weathered - pale yellowish brown (10YR6/2); matrix 75-85%, grains 15-25%; grains crinoid and undetermined fossil debris with many crushed spores near top; grain size 1.5 cm or less; bedding 10 cm, massive.

5 Biomicrite; color, unweathered - light gray (N7) to light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); matrix 40-50%, cement 20-30%, grains 30-40%; grains crinoid and brachiopod fragments (Atrypa) and spores; grain size 1.7 cm or less; sorting poor; bedding 6 cm with some black laminae at top and base.

4 Biomicrite; color, unweathered - light gray (N7) to light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); matrix 25-35%, grains 65-75%, grains brachiopod, coral, bryozoan, crinoid and undetermined fragments plus a few spores; grain size 1 cm or less; sorting poor; bedding massive with irregular black laminae at the base.

3.5 Crinoid biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - pale yellowish brown (10YR6/2); matrix 50-60%, grains 40-50%; grains crinoid, coral, bryozoan, and undetermined fragments plus spores; grain size 1 cm or less; sorting poor; bedding 7 cm with two .1 cm shaley stylolitic bands plus other black irregular laminae; some partial silicification in corals.

3 Biomicrite; color, unweathered - pale yellowish brown (10YR6/2), weathered - dark yellowish brown (10YR4/2); cement 20-30%, matrix 30-40%, grains 30-40%; grains crinoid and undetermined fragments plus spores; grain size .1 cm or less; bedding 6.6 cm with some irregular black laminae at top and base.

2 Micrite; color, unweathered - medium light gray (N6); weathered - dark yellowish brown (10YR4/2); matrix 85-95%, grains 5-10%; grains shell fragments and spores; grain size 1 cm or less; bedding 5 cm with some irregular black laminae; pyrite present.

1 Mottled biomicrite; color, unweathered - light gray (N7) to pale yellowish brown (10YR6/2), weathered - pale yellowish brown (10YR6/2); matrix 55-65%, grains 35-45%; grains coral, bryozoan, trilobite, brachiopod, crinoid and undetermined debris plus spores; grain size 2 cm or less; sorting poor; bedding 9 cm, massive; some silicification of fossil debris.

0* Intrasparite; color, unweathered - pale yellowish brown (10YR6/2), weathered (10YR6/2); matrix 20-30%, cement 40-50%, grains 20-30%; grains angular intraclasts from underlying Detroit River Group; grain size 5.0-1.4 cm; grains tabular; bedding 8 cm with some fine, graded bedding in clasts and matrix; pyrite crystals in matrix; yellowish stylolitic seam at base with much pyrite; seam weathers rust-colored at contact between formations.

Locality 85803 - .5 Mile South of

Marburg, Near Lake Erie

# Feet Above Base	Description of Lithology
0	Biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 80-90%, grains 10-20%, grains brachiopod and crinoid fragments; grain size 1.3 cm to less than .1 cm; bedding medium.

Locality 85804 - Lake Erie Shore

# Feet Above Base	Description of Lithology
3	Biomicrite; color, unweathered - olive gray (5Y4/1) to light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 80-90%, grains 10-20%; grains crinoid and brachiopod ossicles; grain size .6 cm to less than .1 cm; bedding medium.
2	Biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 80-90%, grains 10-20%; grains primarily crinoid with some coral, brachiopod and unidentified debris; grain size .2 cm or less; bedding medium with discontinuous wavey brown laminae; stylolites present.
1	Crinoid biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 10-20%; cement 5-10%, grain 80-90%; grains primarily crinoid ossicles with some brachiopod shell fragments; grain size .5 to .4 cm; well sorted; bedding 3 cm.
0	Crinoid biomicrite; color, unweathered - olive gray (5Y4/1), weathered - yellowish gray (5Y8/1); matrix 30-40%, grains 60-70%; grains crinoid and coral debris; grain size 1 cm to less than .1 cm; bedding medium with wavey brown laminae.

Locality 85805 - 1.5 Miles West of Nanticoke, Near Lake Erie

# Feet Above Base	Description of Lithology
2	Crinoid biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 15-20%, grains 75-85%; grains primarily crinoid ossicles with some brachiopod and coral fragments; grain size 1.3 to less than .1 cm; sorting poor; bedding thin with a few discontinuous gray laminae.
1	Crinoid biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 15-25%, grains 75-85%; grains primarily crinoid ossicles with some corals; grain size greater than 1 cm to less than .1 cm; bedding medium; stylolites present.
0	Coral biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 60-70%, grains 30-40%; grains whole rugose corals (*Acinophyllum*) in life position; sorting of matrix good; bedding thick, massive; corals act as sediment binders.

Locality 85806 - On Schweyer Farm Along Dry Creek Near Lake Erie

# Feet Above Base	Description of Lithology
23	Micrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 95-100%, grains 5%; grains unidentified shell fragments; grain size less than .1 cm, sorting good; bedding thick with poorly developed laminae; some dolomitization.
22	Burrowed biomicrite; color, unweathered - olive gray (5Y4/1), weathered, yellowish gray (5Y8/1); matrix 100% very fine-grained; well-sorted; bedding medium with disrupted layering; some pyrite, dolomite present.
21	Burrowed biomicrite; color, unweathered - olive gray (5Y4/1), weathered - olive gray (5Y4/1); matrix 95%, grains 5%; grains crinoid and unidentified debris; grain size .1 cm or less; bedding thick with disrupted layers.
20	Burrowed biomicrite; color, unweathered - olive gray (5Y4/1), weathered - yellowish gray (5Y8/1); matrix 100%; sorting good; bedding thick, burrowed.
19	Burrowed biomicrite; color, unweathered - olive gray (5Y4/1); weathered - light olive gray (5Y6/1); matrix 95-100%, grains 5%; grains crinoid ossicles and unidentified fragments; grain size .1 cm and less; bedding thick with burrows.
18	Micrite; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 95%, grains 5%; grains brachiopod and coral fragments; grain size 2 cm or less; sorting poor; shell fragments subparallel to bedding; bedding thick; pyrite replaces part of brachiopod shell.
17	Covered
16	Covered
15	Covered
14	Burrowed biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 95-100%, grains 5%; grains broken shell fragments; grain size .1 cm or less; bedding thick and disrupted.

13 Burrowed biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 85-95% grains 5-15%; grains coral, brachiopod and possible protozoan shells; grain size .6 cm or less; bedding thick and disrupted; some partial silicification of fossils.

12 Burrowed biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - light olive gray (5Y6/1); matrix 85-95%, grains 5-15%; grains coral, gastropod, brachiopod and unidentified fragments; grain size .5 cm and less; bedding thick and disrupted.

11 Biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - light olive gray (5Y6/1); matrix 75-85%, grains 15-25%; grains coral and shell fragments; grain size 2 cm and less; bedding thick; coral walls partially silicified.

10 Burrowed biomicrite; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); matrix 80-90%, grains 10-20%; grain size 1.5 cm or less; bedding medium disrupted.

9 Burrowed biomicrite; color, unweathered - olive gray (5Y4/1), weathered - light yellowish gray (5Y8/1); matrix 70-80%, grains 20-30%; grains crinoid and bryozoan ossicles, Acinophyllum; grain size 2 cm or less; bedding thick and disrupted; silica partially replaces some fossil fragments.

8 Burrowed biomicrite; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 75-85%, grains 15-25%; grains corals and shell fragments; grain size 1 cm or less; bedding thick and disrupted; corals partially recrystallized.

7 Burrowed biomicrite; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 85-95%, grains 5-15%; grains crinoid, brachiopod, coral and sponge spicule fragments; grain size .9 cm or less; bedding massive and disrupted; corals partially replaced by silica, some pyrite in irregular masses.

6 Micrite; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 95-100%, grains 5%; grains broken shell fragments; grain size .1 cm or less; bedding thick; chert present, some fossil fragments silicified.

5 Micrite; color, unweathered - olive gray (5Y4/1), weathered-medium light gray (N6); matrix 95-100%, grains less than 5%; grains small shell fragments; grain size less than .1 cm; bedding thick; some banded chert nodules.

4	<u>Burrowed</u> <u>biomicrite</u>; color, unweathered - olive gray (5Y4/1), weathered - olive gray (5Y4/1); matrix 95-100%, grains 0-5%; grains shell fragments; grain size .2 cm or less; bedding thick; small chert nodules present.
3.5	<u>Biomicrite</u>; color, unweathered - olive gray (5Y4/1), weathered - olive gray (5Y4/1), matrix 55-65%, grains 45-55%; grains a sponge with spicules, shell fragments; grain size .3 cm or less; bedding thick.
3	<u>Biomicrite</u>; color, unweathered - olive gray (5Y4/1), weathered - olive gray (5Y4/1); matrix 85-95%, grains 5-15%; grains unidentified fragments; grain size less than .1 cm; bedding thick and disrupted; pyrite present.
2	<u>Burrowed</u> <u>biomicrite</u>; color, unweathered - dark yellowish brown (10YR2/2), weathered - yellowish gray (5Y8/1); matrix 95-100%, grains 0-5%; grains unidentified fossil fragments; grain size less than .1 cm; bedding thick and disrupted; euhedral pyrite.
1	<u>Micrite</u>; color, unweathered - olive black 5Y2/1), weathered - light olive gray (5Y6/1); matrix 100%; well sorted, very fine-grained; bedding thick.
0	<u>Micrite</u>; color, unweathered - olive black (5Y2/1), weathered - light olive gray (5Y6/1); matrix 100%; well sorted; very fine-grained; bedding thick; pyrite in masses aligned parallel to bedding.

Locality 85807 - Brunner Mond Quarry, Allied Chemical Co., Amherstburg

# Feet Above Base	Description of Lithology
1	<u>Biosparite</u>; color, unweathered - light olive gray (5Y6/1), weathered - yellowish gray (5Y8/1); cement 40-50%, grains 50-60%; grains crinoid, brachiopod, bryozoan, coral and other skeletal debris; grain size 2.5 cm to less than .1 cm; bedding thick.
0	<u>Biomicrite</u>; color, unweathered - olive gray (5Y4/1), weathered - light olive gray (5Y6/1); matrix 40-50%; grains quartz sand, bryozoan, crinoid, brachiopod and other skeletal debris; grain size 1.5 cm to less than .1 cm; bedding thick.

APPENDIX B

Results of Insoluble Residue Studies of Samples of the Delaware Limestone from Outcrops in Southwestern Ontario

All of the data with the exception of the column listed Types of Fossils are from the study of hydrochloric acid residues. A 20% solution of HCl was used to dissolve samples of about 30 grams. The liquid plus residue was poured into a filter paper. After drying, the paper was ignited and the residue was weighed. Residue weight was compared with the original weight of the sample and an estimate of insoluble products in the sample was obtained. The residue was disaggregated in water and wet sieved for sand sized grains. After sieving, the sample was examined under a binocular microscope to determine mineral constituents if possible.

Acetic acid residues were also studied. A portion of each sample used was crushed and partially dissolved in a 15% solution of acetic acid. The acid was poured off and the partly dissolved product wet sieved through Tyler Standard Screens Mesh #16 (.991 mm) and Mesh #35 (.0197 mm). Coarser particles were set aside for future study. Finer particles were not studied. That portion of the sample remaining on the final mesh was dried. The residues were then carefully picked for microfossils.

Selected microfossils were separated from each sample and mounted on micropaleontologic slides for further study. Each was carefully noted as to the locality and horizon from which it was obtained.

The following symbols are used in presenting the data in this appendix:

S = Spore	(C) = Carbonaceous
W = Scolecodont	(P) = Pyrite, marcasite
C = Conodont	(SF) = Silicified fossil fragment
F = Fish	(T) = Trace
T = Pteropod	(R) = Rare
O = Charophyte	* = Base of Unit
P = Sponge	

Note that the relative percentages of the various components listed are general visual estimates and have not been derived from point counting or some other more accurate method.

Both sets of residue samples are stored in the collections of the University of Nebraska Department of Geology.

Locality 85789 - Point Farms Provincial Park, 100 Feet South of 85790 Along Small Stream

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
6	1.9	0	100	0	0	0	WCF
5	3.1	0	100	0	0	0	WC
4	2.8	0	100	0	0	0	CAH
3	2.3	0	100	0	0	0	WC
2	3.4	0	100	0	(T)	0	SC
1.5	3.7	0	100	0	(T)	0	SWCO
1	2.3	0	100	0	(T)	0	SP
0	3.4	0	100	0	(T)	0	SCP

Locality 85790 - Point Farms Provincial Park South of Bathing Beach 100 Yards

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
6	3.1	0	100	0	0	0	C
5	1.7	0	100	0	0	0	WCPH
4	2.1	0	100	0	(T)	0	S WCFH
3	2.4	0	100	0	0	0	WCPAH
2	1.8	0	100	0	0	0	WCPH
1	1.3	5	95	0	(T)	0	S WCP
0	2.2	5	95	0	(T)	0	S C

Locality 85791 - Bogies Beach Along Stream

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
17	1.7	0	100	0	(T)	0	S WCFPA
16	covered						
15	3.9	0	100	0	(T)	0	S WCFPA
14	3.1	0	100	0	(T)	0	S FP
13	4.9	0	100	0		0	FP
12	1.3	0	100	0		0	FP
11	1.8	0	99	1		0	
10	3.0	0	100	0		0	P
9	2.3	0	100	0		0	WCA
8	1.8	0	100	0	0	0	WCFA
7	2.2	0	100	0	0	0	WCFPH
6	3.9	0	100	0	(T)	0	S WCFPAH
5	3.2	0	100	0	0	0	WCP
4	2.1	0	100	0	0	0	WCFP
3	5.0	0	98	0	2	0	S
2	2.8	0	95	0	5	0	S WCF
			(coarser)				
1	4.0	0	95	0	5	0	S
0	3.3	0	80	0	20	0	S C

Locality 85792 0 West of the Bridge at Port Albert

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
13	5.2	0	90	0	10	0	S W
12	3.8	0	60	0	40	0	S W
11	3.5	0	97	0	3	0	S CP
10	2.3	0	90	0	10	0	S WCP
9	2.2	0	95	0	5	0	S C
8	1.6	0	95	0	5	0	S H
7	2.7	0	95	0	5	0	S
6	2.4	0	90	5	5	0	S P
5	3.4	0	85	5	10	0	S
4	2.4	0	85	(T)	15	0	S
3	3.8	0	90	0	10	0	S C
2	1.6	0	100	0	(T)	0	S
1	3.5	0	100	0	(T)	0	S
0	5.2	0	95	0	5	0	S

Locality 85793 - Pipers Dam Just East of Goderich on

South Side of Maitland River

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
31	2.4	0	100	0	0	0	CF
30	2.5	0	100	0	0	0	WFP
29	2.4	0	100	0	0	0	CFOH
28	1.2	0	100	0	0	0	CP
27	1.7	0	100	0	0	0	CP
26	1.5	0	100	0	0	0	CH
25	2.8	0	95	0	5	0	S C
24	2.6	0	70	0	30	0	S
23	3.1	0	95	0	5	0	S
22	2.0	0	50	0	50	0	S P
21.5	2.1	0	100	0	0	0	CFP
21	4.5	0	100	0	(R)	0	S WCF
20	2.5	0	75	0	25	0	S
19.5	2.2	0	50	0	50	0	S
19	3.1	0	70	0	30	0	S C
18	1.6	0	100	0	(T)	0	S
17	2.5	0	50	0	50	0	S
16	2.3	0	99	0	1	0	S
15	2.5	0	100	0	(T)	0	S
14	2.4	0	50	0	50	0	S
13	2.1	0	70	0	30	0	S P
12	2.7	0	100	0	(T)	0	S CF
11	3.6	0	80	0	20	0	S
10	3.5	0	70	0	30	0	S
9	2.3	0	80	0	20	0	S
8	3.2	0	60	0	40	0	S
7	2.8	0	90	0	10	0	S
6	2.8	90	10	0	0	0	
5.5	2.7	1	99	0	0	0	
5	2.6	50	50	0	(T)	0	S
4	7.9	80	20	0	(T)	0	S F
3	5.5	30	70	0	(T)	0	S
2	2.9	50	50	0	0	0	
1	21.2	95	0	0	5	0	S
0*	10.7	99	0	0	1	0	S

Locality 85794 - Falls of the Maitland River

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
13	2.7	0	90	10	0	0	
12	2.9	0	100	(T)	0	0	WCFPH
11	2.5	0	100	(T)	0	0	
10	3.5	0	95	5	0	0	
9	3.3	0	95	5	(T)	0	S
8	3.5	0	60	20	20	0	S
7	7.1	0	100	(T)	(T)	0	S
6	5.5	0	75	0	25	0	S
5	6.0	0	60	0	40	0	S
4	4.0	0	100	0	(T)	0	S
3	4.4	0	100	0	0	0	C
2	2.7	0	50	0	0	50(P)	C
1	2.0	0	50	0	50	0	S
0	90.7	0	0	95	5	0	S

Locality 85795 - Along the Maitland River at Benmiller on North Side,

100 Yards West of Bridge Across Maitland River

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
10	2.7	0	90	10(SF)	(T)	0	S WH
9	2.5	0	80	20(SF)	(T)	0	S F
8	4.2	0	70	30	0	0	
7	3.8	0	95	5	0	0	CFP
6	3.3	0	90	10	0	0	CFPH
5	4.6	0	80	20	0	0	F
4	2.4	0	70	30	0	0	C
3	4.4	0	80	20	0	0	C
2	6.0	0	95	5	0	0	C
1	4.9	0	100	0	0	0	No data
0	3.1	0	100	(T)	(T)	0	S C

Locality 85796 - Along the South Bank of the

Maitland River at Goderich

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
4	2.1	0	100	0	(T)	0	S
3	covered						
2	5.4	5	85	0	10	0	S
1	2.4	0	100	0	0	0	
0*	1.7	1	99	0	(T)	0	S

Locality 85797 - Beneath the Bridge at Brussels

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
4	2.5	10	80	10	(T)	0	S WCF
3	3.3	15	70	15	(T)	0	S WCFA
2	1.6	0	90	10	(T)	0	S WCF
1	3.9	0	60	40	5	0	S CF
0	3.6	30	40	30	5	0	S P

Locality 85798 - 3 Miles North of St. Mary's Along Thames River

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
9	2.5	0	100	0	0	0	CF
8	1.2	0	95	5	0	0	C
7	2.6	0	100	0	0	0	C
6	3.4	0	100	0	0	(T)(P)	WCF
5	2.0	0	100	(T)	(T)	(T)(P)	S WCFA
4.5	4.7	0	95	5	(T)	0	S
4	2.0	0	90	5	5	0	S C
3	2.5	0	90	5	5	0	S
2	10.0	0	30	65	5	0	S CF
1	3.2	0	85	15	2	0	S
0	1.3	0	95	5	0	0	No data

Locality 85799 - 2 Miles North of St. Mary's Along Thames River

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
2	6.6	0	95	0	(T)	5(P)	S CFA
1	5.6	0	100	0	(T)	0	S WF
0	3.7	0	95	0	(T)	5(P)	S FA

Locality 85801 - St. Mary's Cement Co. Old Quarry - East Side of Thames River - South of Main Plant - Samples Taken Along North Central Face

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
44	8.4	0	95	0	(T)	5(P)	S WCFA
43	24.4	0	100	0	(T)	0	S A
42	3.5	0	95	0	(T)	5(P)	S WA
41	11.2	0	100	0	(T)	(T)(P)	S WCF
40	5.2	0	95	0	(T)	5(P)	S WCF
39	5.5	0	95	0	(T)	5(P)	S WCF
38	7.9	0	100	0	0	0	No data
37	7.4	0	100	0	(T)	0	S WCF
36	6.9	0	95	0	(T)	5(P)	S WCF
35	6.2	0	100	0	(T)	0	S WCF
34	6.0	0	95	0	C	0	S WC
33	5.9	0	100	0	0	0	WC
32	4.2	0	100	0	0	0	No data
31	1.1	0	100	0	(T)	0	S WCFP
30	4.4	0	100	0	0	0	No data
29	2.9	0	100	0	(T)	0	S WCP
28	3.8	0	100	0	0	0	WCFP
27.8	3.7	0	100	0	0	0	No data
27	3.8	0	100	0	0	0	No data
26	6.5	0	100	0	0	0	WCFA
25	3.5	0	100	0	(T)	0	S WCFA
24	7.9	0	100	0	(T)	0	S WCF
23	3.9	0	100	0	0	0	WCFA
22	6.2	0	100	0	0	0	No data
21	4.2	0	100	0	0	0	WCF
20	3.5	0	100	0	0	0	WCF
19	4.1	0	100	0	0	0	WCFA

Locality 85801 - continued

18	6.5	0	100	0	0	0	WCFHA
17	4.9	0	100	0	0	0	WCF
16	2.9	0	100	0	0	0	WCF
15	8.8	0	100	0	0	0	CF
14	4.1	0	100	0	0	0	No data
13	3.2	0	100	0	0	0	WCFH
12	4.4	0	100	0	0	0	No data
11	2.3	0	100	0	0	(T)(P)	CFO
10	4.7	0	100	0	0	0	WF
9	4.4	0	100	0	0	0	No data
8	3.6	0	100	0	(T)	0	S WCF
7	5.5	0	80	0	(T)	20 (P)	S WCF
6	4.1	0	99	0	(T)	(T)(P)	S WCFH
5	3.5	0	99	0	(T)	0	S WCFTOPH
4	3.1	0	85	0	(T)	15 (P)	S WCFPAH
3	5.9	0	0	5	(T)	95 (P)	S F
2	2.9	0	75	10	(T)	15 (P)	S
1	6.9	10	80	10	(T)	0	S WFP
0*	4.1	20	15	0	(T)	65 (P)	S W

Locality 85802 - St. Mary's Cement Co. New Quarry - West Side

of Thames River - Collection Made Along

West Wall of Ramp

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
41	5.8	0	95	0	(T)	5(P)	S CFWA
40	7.9	0	97	0	(T)	3(P)	S CFW
39	9.4	0	100	0	(T)	0	S CFWA
38	7.6	0	100(silt)	0	C	0	S FWA
37	7.4	0	98	0	(T)	2(P)	S CFWA
36	3.7	0	98	2	(T)	0	S CFWA
35	3.5	0	100	0	0	(T)(P)	CFWA
34	4.5	0	100	0	(T)	0	S PCFWA
33	3.4	0	100	0	0	(T)(P)	PCFWA
32	3.3	0	100	0	(T)	0	S No data
31	2.6	0	98	0	(T)	2(P)	S PFW
30	5.1	0	95	0	0	5(P)	No data
29	4.8	0	100	0	0	(T)(P)	CFA
28	4.4	0	70	0	0	30(P)	CF
27	9.4	0	100	0	(T)	(T)(P)	S PFWA
26	6.3	0	100	0	0	0	CFWA
25	3.7	0	100	0	0	0	No data
24	4.1	0	100	0	0	0	CFW
23	4.4	0	100	0	(T)	0	S CFWA
22	5.8	0	100	0	(T)	0	S PCFWA

Locality 85802 - continued

21	3.7	0	100	0	0	0	PCFWA
20	2.9	0	100	0	0	0	CFAT
19	5.7	0	20	0	0	80(P)	C
18	2.5	0	100	0	0	0	None
17	4.2	0	100	0	(T)	0	S CFW
16	4.1	0	100	0	0	0	CFW
15.6	3.9	0	95	0	0	5(P)	CFO
15	3.7	0	100	0	0	0	CFW
14	3.1	0	99	0	0	0	CFWA
13	6.8	0	99	1	(T)	0	S No data
12	2.7	0	99	0	(T)	0	S CFWO
11	2.9	0	96	2	(T)	0	S No data
10	4.2	0	100	0	(T)	0	S CFWHA
9	2.5	0	99	0	1	0	S PCFWOH
8	3.6	0	95	2	2	0	S PCFW
7	4.0	0	95	0	5	0	S No data
6	2.7	0	99	0	1	0	S No data
5	2.7	0	95	0	5	0	S PCWO
4	1.8	0	99	0	1	0	S PCFW
3.5	3.1	0	99	5	5	0	S PCWH
3	1.9	0	95	0	5	0	S PCOH
2	4.0	0	80	0	10	10(P)	S PACFW
1	2.5	10	60	5	(T)	30(P)	S CFW
0*	2.2	10	60	0	(T)	30(P)	S

Locality 85803 - .5 Mile South of Marburg, Near Lake Erie Shore

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
0	9.6	5	95	0	(T)	0	S FC

Locality 85804 - Lake Erie Shore

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
3	4.2	0	100	0	0	0	
2	4.1	0	90	0	0	10(C)	
1	2.4	0	99	1	0	0	W
0	4.1	0	100	0	0	0	

Locality 85805 - 1.5 Miles West of Nantikoke, Near Lake Erie Shore

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
2	2.6	0	100	0	0	0	
1	10.10	0	100	0	0	0	
0	4.7	0	100	0	0	0	WFC

Locality 85806 - Schweyer Farm Along Dry Creek Near Lake Erie

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
23	9.0	0	100	0	0	0	
22	5.3	0	100	0	0	0	
21	5.5	0	100	0	0	0	W
20	5.2	0	100	0	0	0	W
19	5.8	0	100	0	0	0	W
18	6.5	0	80	15	0	5(P)	
17	Covered						
16	Covered						
15	Covered						
14	4.5	0	100	0	0	0	
13	6.0	0	80	20	0	0	W
12	4.3	0	100	0	0	0	WCA
11	95.6	0	0	100	(T)	0	S
10	4.5	0	100	0	0	0	
9	4.9	0	100	(T)	0	0	
8	5.0	0	95	0	0	5(P)	WPA
7	6.7	0	100	T	0	0	WPA
6	4.6	0	100	0	0	0	W
5	12.70	0	80	20	0	0	
4	4.5	0	100	0	0	0	
3.5	2.3	0	95	5	0	0	WCFA
3	6.0	0	100	(T)	0	(T)(P)	
2	8.6	0	100	0	0	(T)(P)	
1	11.6	0	100	0	0	0	
0	9.4	0	50	0	0	50(P)	

Locality 85807 - Brunner Mond Quarry - Allied Chemical Co. Amherstberg

# Feet Above Base	% Insol.	Relative % Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
1	1.2	5	66	20	20	0	S WC
0*	3.2	100	0	0	0	0	

Locality 85800 - At Top of West Side of Old Quarry in Northeast

Part of St. Mary's - Now a Dump

# Feet Above Base	% Insol.	Sand	Silt, Clay	Chert	Spores	Other	Types of Fossils
3	2.6	0	95	5	(T)	0	S WCFPH
2	2.5	0	95	0	5	0	S PT
1	2.8	0	95	9	5	0	S WC
.5	4.4	5	90	3	1	0	S
0*	5.7	50	50	(T)	(T)	0	S WFP

APPENDIX C

Analysis of Cuttings from Selected Wells

All of the tray numbers and other unlisted data included in this appendix may be found in Sanford (1964). Every lithologic description and thickness included is from the Delaware Limestone.

Elgin County

Tray #	Well Name	Lot	Con.	Township
2224	Cleveland Copper Corp.			Lake Erie
	Delaware 230 to 318 feet; black shales and limestones at top; 20 feet calcareous sandstone at base.			
4403	Christie-Mitchell and Mitchell			Lake Erie
	Delaware 270 to 390 feet.			
755	Dominion National Gas Company	35	2	Malahide
	Delaware 240 to 340 feet; more crystalline toward base.			
991	Dominion National Gas Company	7	5	Yarmouth
	Delaware 353 to 480 feet; 420 to 480 feet light gray with many crinoid fragments; darker color 353 to 420 feet; becomes shaley at 363 feet.			

Huron County

Tray #	Well Name	Lot	Con.	Township
9903	Imperial Oil Company #1	12	LRE	Colborne
	96 - 140 feet encrinal limestone; change in lithology to sugary dolomite at 140 feet. More spar in samples toward base.			
3384	Imperial Oil Company #1	12	MC	Goderich
	Delaware begins at 197 to 207 feet; ends (base) at 270 feet. Chips near contact coarsely crystalline with much calcite spar; rock below contact sugary. Till above Delaware.			
6808	Imperial Oil Company #1	38	11	Hullet
	Till and outwash to 103 feet. 103 to about 163 feet limestone becoming more crystalline toward base.			
6607	Bluewater Oil and Gas	12	11	Mckillop
	Till to 72 feet. 72 to about 120 feet limestone with crinoid ossicles and shell debris. Coarser toward base; more crystalline.			

Huron County

Tray #	Well Name	Lot	Con.	Township
6584	Imperial Oil Ltd. #1	5	2ED	Ashfield
	Delaware Ls. 117 to 132 feet. Description as above.			
6773	Imperial Oil Ltd. #1	8	3ED	Ashfield
	Delaware Ls. 106 to 129 feet. Description as above.			
6417	Felmont Oil Corporation	7	6ED	Ashfield
	Sands and tills above unit. Coarsely crystalline encrinal limestone from 116 to 136. Basal change in lithology very sharp.			
3317	Imperial Oil Ltd.	17	2	West Wawanosh
	Limestone becoming more coarsely crystalline and encrinal toward base from 117 to 154 feet.			
2195	Can. Hemisphere Pet. Co.	13	3	West Wawanosh
	Lithology same as before. Base has quartz sand. Depth in well of unit 115 to 162 feet.			

Middlesex County

Tray #	Well Name	Lot	Con.	Township
613	Union Gas Co. Can. #1	10	10	London
	Delaware from 120 to 180 feet; becomes more coarsely crystalline below 140 feet. Possible brecciation at base. Interpretation base on color variations in chips.			
610	Volcanic Oil and Gas	34	7	West Nissouri
	Delaware 80 to 100 with possible breccia at base. Sugary textured unit below.			
612	Aloka Oil	10	4	West Nissouri
	Delaware 145 to 290 feet, becomes more fossiliferous toward base.			
1178	Union Gas Company Can. #1	8	5	Westminster
	Delaware coarsely crystalline and fossiliferous near base. 287 to 311 feet with sand in basal carbonate.			
980	Union Gas Company Can. #1	4	7	Westminster
	Delaware light gray fossiliferous 240 to 259 feet.			
916	Dominion National Gas Company #1	16	2NTR	North Dorchester
	Delaware 94 to 178 feet; calcareous sandstone at base; limestone massive to more crystalline near base.			
5679	Canadian Emjay #1	20	9	Biddulph
	Delaware from 115 to 260 sandy at base.			
4555	Sweetgrass-Napiron	28	1	Biddulph
	Delaware 190 to 259 feet darker from 190 to 215, more fossiliferous toward base.			
3204	United Reef Petrol. #1	9	15	McGillivray
	Delaware from 290 to 340 feet lighter and with more fossil debris toward base.			
8413	Imperial Oil Ltd. #1A	9	17	McGillivray
	Delaware from 150 to 223 feet becomes more sparry toward base.			

Middlesex County - continued

Tray #	Well Name	Lot	Con.	Township
8471	Imperial Oil Ltd. #1	9	17	McGillivray
	Delaware from 135 to 220 feet; description like 8413.			
3780	Imperial Oil Ltd. #2	8	3NER	Adelaide
	Very dark shale and limestone grades into Delaware at 267 feet; Delaware 267 to 330 feet.			

Norfolk County

Tray #	Well Name	Lot	Con.	Township
1534	Dominion National Gas #2	7	2	Woodhouse
	Delaware gray limestone with chert 150 to 330 feet. Underlying unit dark carbonate with possible gypsum laths.			
110	Dominion National Gas #2	5	3	Woodhouse
	Delaware limestone with much chert. 475 to 495 feet.			
4196	Roberts and Hessin #1	3	4	Woodhouse
	Chert and limestone 57 to 98 feet.			
1284	Walter Gas Syndicate #1	8	5	Woodhouse
	80 to 165 feet. Cherty throughout, more fossiliferous and more coarsely crystalline throughout. Sand at 165 feet. Unit below has sugary texture.			
1434	Dominion National Gas Company #1	4	6	Woodhouse
	Delaware light gray and cherty. 168 to 186 feet.			

Oxford County

Tray #	Well Name	Lot	Con.	Township
707	Western Ontario Gas Company	21	12	Dereham
	Delaware 190 to 250 feet; micritic at top, more coarsely crystalline toward base.			
1488	Imperial Oil Ltd.	8	10	South Norwich
	Delaware 156 to 180 feet, dark to light gray, chert present.			
1144	Norwich and Otterville	2	11	South Norwich
	Delaware 122 to 281 feet; limestone with chert throughout.			
1466	Imperial Oil Ltd.	5	11	South Norwich
	Delaware 120 to 146 feet; chert present.			

Perth County

Tray #	Well Name	Lot	Con.	Township
4796	Canadian Delhi Oil Company	5	15	Blanchard
	Delaware 50 to 81 feet, generally more coarsely crystalline toward base.			
719	Volcanic Gas and Oil	21	18	Blanchard
	Delaware 0 to 42 feet, chert present; limestone darker near top.			

APPENDIX D

Measurements and Stratigraphic Positions of Fossils from the Delaware Limestone

Included in this appendix are listings for most of the fossils collected during this study. Some forms have been excluded because their distribution can be readily obtained from Appendix B.

Where letters are used to designate localities they correspond to the Geological Survey of Canada Localities used in this paper in the following manner:

G.S.C. #	Letter Designation
85789	H
85790	G
85791	I
85792	J
85793	O
85794	Q
85795	L
85796	K
85797	P
85798	E
85799	F
85800	S
85801	D
85802	R
85803	B
85804	A
85805	C
85806	M
85807	N

A * indicates a well preserved specimen.

Microfossil Distribution

PHYLUM THALLOPHYTA

CLASS CHAROPHYTA

<u>Moellerina greenei</u>

UNSM #	Slide #	Loc. #	LPA (mm)	LED (mm)	LPA/LED
8800	B6	D5	.78 mm	1.00 mm	.78
8801	C1	D11	.85	.93	.92
8801	C4	D11	.75	.90	.84
8801	C8	D11	.75	.95	.79
8802	K6	R3	---	---	---
8803	K22	R5	.65	1.00	.65
8804	K53	R9	.50	1.00	.50
8805	L33	R12	--	---	---
8806	M14	R15.6	.70	.88	.80
8807	V46	029	.80	1.00	.80
8807	V51	029	.78	1.00	.78
8808	W15*	H1.5	.75	.98	.77

LPA = Length of polar axis

LED = Largest equatorial diameter

PHYLUM PROTOZOA

Arenaceous Foraminifera with Main Characteristics

UNSM #	Slide #	Loc. #	Species	# Chambers	Chamber Diam. (mm)	Test Diam. (mm)	Test Color	Test Form
8809	A42	D4	<u>P. delicatula</u>	1	.37		Am	Glob
8810	E53	D18	<u>P. delicatula</u>	1	.30		Am	Glob
8811	F51	D23	<u>P. delicatula</u>	1	.30		Am	Glob
8812	H9	D25	<u>W. sola</u>	1	.35		Am	Pl-Co
8813	J4	D39	<u>W. sola</u>	1	.75		Am	Pl-Co
8813	J5	D39	<u>S. bicelloidea</u>	2	.45	.80	Wh	Pl-Co
8814	J35	D42	<u>W. sola</u>	1	.40-.60		Wh	Pl-Co
8814	J38	D42	<u>W. sp.</u>	1	.25		Wh	Pl-Co
8814	J39	D42	<u>W. sola</u>	1	.40-.60		Wh	Pl-Co
8815	J40	D43	<u>W. sola</u>	1	.40-.75		Wh	Pl-Co
8816	J43	D44	<u>W. similis</u>	2	.60	.90	Wh	Pl-Co
8817	J48	R2	<u>P. devonica</u>	1	.50		Am	Glob
8817	J55	R2	<u>P. delicatula</u>	1	.25		Am	Glob
8818	K25	R5	<u>P. delicatula</u>	1	.40		Am	Glob
8819	L19	R10	<u>P. delicatula</u>	1	.30		Am	Glob
8820	L55	R14	<u>P. rotunda</u>	1	.65		Am	Glob
8821	M55	R20	<u>W. sp.</u>	1	.20		Am	Pl-Co
8822	N12	R21	<u>P. delicatula</u>	1	.30		Am	Glob
8823	N56	R22	<u>S. columbiense</u>	2	.60	1.00	Am	Glob
8824	023	R23	<u>P. rotunda</u>	1	.67		Am	Glob
8825	P10	R26	<u>P. discoidea</u>	1	.20		Am	Glob
8825	P51	R26	<u>S. bicelloidea</u>	2	.25	.40	Am	Glob
8826	Q6	R27	<u>S. columbiense</u>	2	.60	1.05	Am	Glob
8827	Q23	R29	<u>P. devonica</u>	1	.40		Am	Glob
8828	Q51	R33	<u>W. sp.</u>	1	.10		Am	Pl-Co
8829	R7	R34	<u>S. bicelloidea</u>	2	.15	.35	Am	Pl-Co
8830	R43	R35	<u>W. sola</u>	1	.40		Wh	Pl-Co
8831	S16	R36	<u>S. bicelloidea</u>	2	.20	.35	Am	Pl-Co
8832	S22	R37	<u>W. sola</u>	1	.30		Am	Pl-Co
8833	S27	R38	<u>S. bicelloidea</u>	2	.25	.50	Am	Pl-Co
8834	S33	R39	<u>W. sola</u>	1	.34		Wh	Pl-Co
8834	S37	R39	<u>W. polygonia</u>	3	.25	.75	Am	Pl-Co
8835	S55	R41	<u>W. sola</u>	1	.60		Am	Pl-Co
8835	S59	R41	<u>W. sola</u>	1	.50		Am	Pl-Co
8836	T33	G3	<u>P. delicatula</u>	1	.27		Am	Glob
8836	V45	P3	<u>S. columbiense</u>	2	.60	1.20	Am	Glob
8837	W25	H5	<u>P. delicatula</u>	1	.20		Am	Glob
8838	W59 (6)	E5	<u>S. bicelloidea</u>	2	.25	.60	Am	Glob
8839	Y34	I7	<u>S. bicelloidea</u>	2	.30	.65	Am	Glob
8840	Y48	I7.5	<u>W. sola</u>	1	.50		Am	Pl-Co
8841	Y59	I9	<u>W. sola</u>	1	.60		Am	Pl-Co
8842	Z14	I10	<u>W. similis</u>	2	.50	1.00	Am	Pl-Co

8843	Z27	I16	W. sola	1	.37		Am	Pl-Co
8844	Z37	I18	S. columbiense	2	.50	1.10	Am	Glob
8845	AA32	M8	P. devonica	1	.50		Am	Glob
8846	AA34 (8)	M9	S. columbiense	4	.50	1.25	Am	Glob
8847	AA41 (9)	M13	P. delicatula	1	.35		Am	Glob
8848	AA46 (7)	F1	W. polygonia	4	.50	1.00	Wh	Pl-Co
8849	AA50	F3	W. sola	1	.60		Am	Pl-Co

Key to Abbreviations

Am = Amber
Wh = White
Glob = Globular
Pl-Co = Plano-Convex

PHYLUM ANNELIDA

<u>Staurocephalites</u> Measurements

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)
8850	A18	D1	.75	.40
8850	A20	D1	1.00	.50
8851	C35	D13	.40	.15
8852	D50	D16.5	.50	.13
8853	D56	D17	.55	.35
8854	E10	D18	.50	.13
8855	F35	D21	1.25	.15
8855	F36	D21	1.35	.30
8856	I50	D36	.90	.40
8857	K21	R4	.35	---
8858	L23	R10	.75	.25
8859	M36	R16	.50	.10
8860	N27	R21	.40	.15
8861	N59	R22	.90	.25
8862	O15	R23	.40	.15
8862	O20	R23	.50	.12
8863	O41	R24	.85	.30
8864	P12	R26	1.35	.50
8865	Q53	R33	.75	.25
8865	Q54	R33	2.00	.35
8866	R17	R34	.75	.20
8867	S23	R37	.65	---
8868	T8	G1	.52	.15
8869	U24	S3	.75	.15
8870	U35	P2	.51	---
8871	V34	H7	1.00	.15
8872	Z57	J10	.52	---
8873	AA33(10)	M8	.75	---

Arabellites Measurements

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)
8874	A39	D4	.50	.15
8875	G3	D24	.75	.40
8876	H40	D28	.40	.23
8877	H53	D29	.50	.15
8878	I18	D34	.55	.30
8879	J31	D41	.60	.25
8879	J36	D41	.50	.15
8879	J37	D41	.60	.25
8880	T17	G1	.50	.17
8881	V20	021	.50	.25
8882	Y51	I7.5	.50	.15
8882	Y52	I7.5	.45	.12
8883	Y57	I8	.60	.12
8884	AB5	D34	.80	.25

Leodicites Measurements

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)
8885	A2(12)	D0	.60	.15
8885	A5	D0	.55	---
8885	A12	D0	1.00	.65
8885	A15	D0	.75	.50
8885	A17	D0	.70	.50
8886	A19	D1	.75	.30
8886	A22	D1	1.30	.55
8887	A53	D4	.55	.35
8888	B10	D5	.35	.32
8889	C14	D13	.50	.25
8889	C25	D13	.45	---
8890	D49	D16.5	1.00	.30
8891	E44	D18	.35	---
8891	F6	D18	.35	.15
8891	F7	D18	.60	.20
8891	F13	D18	.50	.30
8892	F29	D19	.40	.17
8893	F38	D21	.40	.32
8894	F56	D23	.42	.15
8895	F59	D24	.35	.15
8896	I4	D31	.90	.25
8897	I43	D36	.85	.40
8898	J42	D44	.30	.25
8899	J45	R1	.50	---
8900	K23	R5	.50	.25
8901	L13	R9	.75	.40
8902	L22	R10	.50	.35
8903	M31	R16	.30	.15
8904	N26	R21	.40	.25
8905	N44	R24	.60	.25
8906	Q29	R31	.85	.25
8907	R14	R34	1.10	.30
8907	R20	R34	.55	.25
8907	R21	R34	.25	.12
8908	S57	R41	1.00	.50
8909	T44	G3	.75	.20
8910	U8	G5	.40	.15
8911	U15	S1	.40	.2
8912	U34	P2	.52	.20
8913	W33	H7	.55	---
8914	X1	E5	.65	.12
8915	Y6	I5	.45	---
8916	Y17	I7	.75	.20
8917	Y41	I7.5	.50	.25
8917	Y49	I7.5	.65	.30
8918	Z3	I9	.25	---
8919	Z26	I16	.62	.20

8920	Z40	I18	.40	.15
8921	Z54	J10	.45	.15
8922	AA1	J13	1.00	.25
8923	AA28	M7	.60	.25
8924	AA36	M9	.50	.25
8925	AA40	M13	.45	.20
8925	AA42	M13	.55	.15
8926	AB1	M9	1.10	.25
8927	AB3	D29	1.40	.50
8928	AB13	D36	1.10	.35

Paleoenoites Measurements

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)
8929	A4	D0	.50	.25
8929	A9	D0	.90	.75
8930	G2	D24	.62	.30
8931	G31	D25	.50	.40
8931	H2	D25	.50	---
8932	H18	D26	.30	.15
8933	I3	D31	---	.35
8934	I15	D34	.50	.35
8935	I47	D36	.50	---
8935	I48	D36	.50	---
8936	I53	D37	.70	---
8937	J3	D39	.40	.25
8937	J9	D39	.50	---
8938	J13	D40	.55	---
8939	032	R23	.50	.30
8940	049	R24	.65	.30
8941	P1	R26	.50	.25
8942	S40	R40	.65	---
8942	S42	R40	.67	---
8943	S51	R41	.75	---
8944	AA22	M2	.55	---

Ildraites Measurements

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)
8945	A3	D0	.45	.25
8945	A8	D0	1.10	.55
8946	B56	D10	.75	---
8947	H52	D29	.50	.15
8948	K20	R4	.50	.30
8949	N58	R22	.55	.25
8950	Q7	R27	.80	.60
8951	S35	R39	.55	.30
8952	T30	G2	.51	.25
8953	V14	S0	1.00	.85
8954	V50	P4	.50	.20
8955	V53	030	.25	.15
8956	Z15	I10	1.65	.65

Anisocerasites Measurements

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)
8957	F43	D21	.50	.35
8958	G16	D24	.30	.25
8958	G23	D24	.35	.27
8958	G26	D24	.40	.35
8959	AB13	D39	.50	.35
8960	AB13	D40	1.00	.60

Lumbriconereites Measurements

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)
8961	A6	D0	.40	.15
8961	A11(14)	D0	1.15	.55
8962	B19	D7	.52	.35
8963	F9	D18	1.10	.30
8964	F26	D19	.50	.20
8965	F57	D24	.75	.25
8965	G28	D24	.90	.40
8966	H1	D25	1.10	.40
8967	I35	D35	1.10	.30
8968	I58	D37	.70	.25
8968	J2	D37	.75	.20
8969	J59	R2	1.30	.55
8970	K54	R9	.50	.25
8971	L29	R12	1.25	.40
8972	P40	R26	.60	.25
8973	Q42	R33	1.00	.30
8974	Q56	R34	1.05	.30
8974	R13	R34	.60	.25
8975	R58	R35	.52	.40
8976	S15	R36	1.40	.50
8977	S25	R38	1.50	.45
8978	S29	R39	1.70	.50
8979	S38	R40	1.10	.25
8980	S52	R41	1.80	.78
8980	S53	R41	1.05	---
8981	W29	H6	.80	.30
8982	Y26	I7	.60	.15
8983	Z35	I18	1.25	.35
8984	AA1	J13	.50	---
8985	AA43	M13	.50	---
8986	AB2	M21	.60	---

Nereidavus Measurements

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)
8987	B1	D5	1.60	.65
8988	D18	D13	.52	.17
8989	E38	D18	.45	.22
8989	E39	D18	.50	.12
8990	F41	D21	.50	.30
8991	H55	D29	.45	.15
8992	I2	D31	.40	.35
8993	I59	D37	.52	.30
8993	I60	D37	.45	.15
8994	K57	R9	.70	.15
8994	L6	R9	1.65	.50
8995	O11	R22	.87	.15
8996	Q37	R33	1.00	.25
8996	Q41	R33	.55	---
8997	R1	R34	.65	.15
8998	R34	R35	1.62	.45
8999	S21	R37	.70	.15
9000	S45	R40	.75	---
9001	S48	R41	.63	---
9002	U50	P4	.50	.20
9003	X25	C0	1.50	.55
9004	X51	I3	.35	.15
9005	Y11	I6	.80	.30
9006	Y60	I9	.50	.15
9007	Z9	I10	1.30	.80
9008	Z40	I18	1.00	---
9009	AA47	F2.5	.55	.20
9009	AA48(14)	F2.5	.50	.20
9010	AB4	D32	.50	.40

Drilonereisites Measurements

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)
9011	A1	D0	1.40	.35
9011	A10	D0	1.35	.40
9011	A13	D0	1.30	.45
9011	A14	D0	.60	---
9012	A46	D4	.65	.30
9013	B7	D5	.70	.25
9014	C39	D13	.87	.25
9015	E5	D18	1.40	.50
9016	K1	R2	.75	.25
9017	K36	R8	.70	.25
9018	M1	R14	.70	.25
9019	M8	R15	.65	.20
9020	08	R22	.65	.25
9021	U41	P3	.75	.21
9021	U48	P3	.70	.20
9022	W17	H2.5	.95	.25
9023	W22	H4	.85	.32
9024	X2	E6	1.00	.30

Siluropelta Measurements

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)
9025	G12(3)	D24	.60	.10
9026	07	R22	.90	.25
9027	U5	G4	.67	.50

CLASS CONODONTOPHORIDA

Measurements of Angulodus

UNSM #	Slide #	Loc. #	Length (mm)	Other Characteristics
9028	A40*	D4	.65	denticles widely spaced
9029	B44	D8		
9030	C26	D13		
9030	C33	D13		
9030	D6	D13		
9031	E41	D18		
9031	F16	D18		
9032	F33	D19		
9033	G43	D25		
9034	H47*	D28	1.10	denticles closely spaced
9035	I7	D31		
9036	K11	R3.5		
9037	L14	R9		
9038	L43	R14		
9038	L54	R14	.35	denticles widely spaced
9039	N9	R21		
9040	016	R23		
9041	P35	R26	.45	denticles widely spaced
9042	Q36	R33	.37	denticles widely spaced
9043	R22	R34		
9043	R23	R34		
9043	R24	R34		
9044	T1	G0	1.00	denticles widely spaced
9045	V30	P1	.75	denticles widely spaced
9046	V57	Q2		
9047	X35	C1	.70	denticles widely spaced
9048	Y2	I5		denticles widely spaced
9049	Y7	F5	.70	denticles widely spaced
9050	Z56	J10	1.00	denticles widely spaced
9051	AA5	L4	.62	denticles wide to narrow

Measurements and Species of Hindeodella

UNSM #	Slide #	Loc. #	Dimensions (mm) width of bar	# of small dent.	Name
9052	A43	D4	.13	2	H. lambtonensis
9053	B8	D5	.10	2	H. austinensis
9054	B22	D8			H. sp.
9054	B34	D8	.13	1	H. austinensis
9054	B45	D8	.15	2	H. lambtonensis
9054	B48	D8	.15	2-3	H. austinensis
9055	C15	D13	.15	2	H. austinensis
9055	C17	D13	.15	2	H. lambtonensis
9055	C19	D13	.10	2	H. austinensis
9055	C28	D13	.13	2	H. austinensis
9055	C40	D13	.13	1	H. austinensis
9055	C45	D13	.13	1-3	H. lambtonensis
9055	C48	D13	.10	1	H. lambtonensis
9055	C54	D13	.10	1	H. lambtonensis
9055	C56	D13	.10	1	H. lambtonensis
9055	C57	D13	.10	1	H. lambtonensis
9055	C58	D13	.13-.15	2	H. lambtonensis
9055	D1	D13	.13	1	H. austinensis
9055	D5	D13	.13	2	H. austinensis
9055	D16	D13	.15	1-2	H. lambtonensis
9055	D17	D13	.15	1-2	H. lambtonensis
9055	D23	D13	.15	1-2	H. lambtonensis
9056	D35	D15	.13	2	H. austinensis
9057	E22	D18	.15	1	H. lambtonensis
9057	E37	D18	.15	2	H. lambtonensis
9057	E41	D18	.13	?	
9057	E52	D18	.13	1	H. austinensis
9057	E60	D18	.10	1	H. lambtonensis
9057	F3	D18	.15	2	H. austinensis
9057	F18	D18	.13	1	H. lambtonensis
9057	F19	D18	.10	1	H. lambtonensis
9057	F25	D18	.13	2	H. austinensis
9058	I17	D34	.13	2	H. austinensis
9059	I54	D37	.25	1	H. austinensis
9080	J44	R1	.20	1-3	H. lambtonensis
9081	K4	R3	.13	2	H. austinensis
9082	K13	R3.5	.13	1	H. austinensis
9083	K17	R4	.20	2	H. lambtonensis
9084	K31	R8	.17	1-3	H. austinensis and H. lambtonensis
9084	K38	R8	.13	1	H. lambtonensis
9084	K39	R8	.13	1-2	H. lambtonensis
9084	K40	R8	.15	1	H. lambtonensis
9084	K45	R8	.13	2	H. lambtonensis

UNSM #	Slide #	Loc. #	Dimensions (mm) width of bar	# of small dent.	Name
9084	K49	R8	.15	1	H. austinensis
9084	K50	R8	.15	1	H. austinensis
9085	L1	R9	.13	3	H. lambtonensis
9085	L11	R9	.15	1	H. austinensis
9086	L25	R10	.13	1	H. lambtonensis
9087	L30	R12	.10	2	H. austinensis
9088	L44	R14	.13	1	H. lambtonensis
9088	L48	R14	.15	3	H. lambtonensis
9088	L50	R14	.15	3	H. lambtonensis
9088	L56	R14	.15	1-3	H. lambtonensis
9088	L57	R14	.15	3	H. lambtonensis
9088	L58	R14	.13	3	H. lambtonensis
9088	L59	R14	.15	1-2	H. austinensis
9088	L60	R14	.15	1-2	H. austinensis
9089	M3	R14	.13	1	H. austinensis
9089	M4	R14	.10	2	H. lambtonensis
9090	M5	R15	.10	2	H. lambtonensis
9090	M11	R15	.13	2	H. lambtonensis
9090	M12	R15	.13-.15	2 or more	H. lambtonensis
9091	M18	R15.6	.15	2	H. lambtonensis
9091	M23	R15.6	.13	2	H. lambtonensis
9092	M26	R16	.13	2	H. lambtonensis
9092	M27	R16	.13	2	H. austinensis
9092	M28	R16			H. austinensis
9092	M35	R16	.17	2	H. austinensis
9092	M38	R16			H. austinensis
9092	M41	R16			H. austinensis
9093	M57	R20	.13	1	H. lambtonensis
9093	M58	R20	.13	2	H. lambtonensis
9093	N7	R20	.15	2	H. lambtonensis
9094	N24	R21	.10	2	H. lambtonensis
9094	N28	R21	.10	2	H. lambtonensis
9094	N39	R21	.10	3	H. lambtonensis
9094	N40	R21	.13	2	H. lambtonensis
9094	N51	R21	.13	3	H. lambtonensis
9095	04	R22	.10	2	H. lambtonensis
9095	09	R22	.20	3	H. austinensis
9095	010	R22	.13	2	H. austinensis
9096	021	R23	.13		H. austinensis
9096	031	R23	.08	1	H. lambtonensis
9097	038	R24	.13	2	H. austinensis
9097	051	R24	.13	2	H. austinensis
9098	P9	R26	.13		H. austinensis
9098	P20	R26	.15	2	H. austinensis
9098	P24	R26	.10		H. lambtonensis
9098	P38	R26	.15	3	H. austinensis
9098	P45	R26	.13	2	H. austinensis
9098	P55	R26	.10	2	H. lambtonensis
9098	P56	R26	.12	4	H. austinensis

UNSM #	Slide #	Loc. #	Dimensions (mm) width of bar	# of small dent.	Name
9098	Q1	R26	.15	2	H. austinensis
9098	Q2	R26	.15		H. austinensis
9099	Q15	R28			H. lambtonensis
9100	R8	R34	.13		H. sp. undt.
9100	R16	R34	.15	3	H. lambtonensis
9101	R50	R35	.10		H. austinensis
9102	S6	R36	.13	3	H. lambtonensis
9103	T5	G1	.15	4	H. lambtonensis
9103	T6	G1	.15	4	H. lambtonensis
9103	T13	G1	.13		H. lambtonensis
9103	T14	G1	.15	4	H. lambtonensis
9103	T15	G1	.13	2	H. lambtonensis
9103	T18	G1	.13	5	H. lambtonensis
9104	T28	G2	.13	2	H. lambtonensis
9104	T29	G2	.13		H. lambtonensis
9104	T31	G2	.15	3	H. lambtonensis
9105	T38	G3	.13	2	H. austinensis
9105	T40	G3	.03	5	H. lambtonensis
9105	T41	G3	.15		H. austinensis
9105	T42	G3	.13	2	H. austinensis
9105	T47	G3	.13	3	H. lambtonensis
9105	T50	G3	.13		H. austinensis
9105	T52*	G3	.13	4	H. lambtonensis
9106	T58	G4	.10		H. austinensis
9106	T59	G4	.15	5	H. lambtonensis
9106	U1	G4	.15	4	H. lambtonensis
9106	U4	G4	.13	2	H. austinensis
9107	U32	P2	.13	3	H. lambtonensis
9108	U56	Q2	.13		H. austinensis
9109	U58	Q3	.15	2	H. austinensis
9110	V11	O21	.13	2	H. austinensis
9111	V23	O21.5	.13		H. lambtonensis
9111	V25	O21.5	.13		H. lambtonensis
9112	V59	O31	.13		H. lambtonensis
9113	W6	BO	.13		H. lambtonensis
9113	W7	BO	.10		H. lambtonensis
9114	W13	H1	.13		H. lambtonensis
9115	W18	H3	.13		H. lambtonensis
9115	W19	H3	.10		H. lambtonensis
9116	W24	H4	.08		H. lambtonensis
9117	W27	H5	.13	3	H. lambtonensis
9118	W30	H6	.13		H. lambtonensis
9119	W48	E4	.13	2	H. austinensis
9119	W49	E4	.13		H. austinensis
9119	W50	E4	.13		H. lambtonensis
9119	W63	E4	.13		H. austinensis
9119	W54	E4	.13		H. lambtonensis
9120	W58	E5	.15		H. austinensis
9120	W60	E5	.13		H. lambtonensis

UNSM #	Slide #	Loc. #	Dimensions (mm) width of bar	# of small dent.	Name
9121	X7	E6	.13		H. lambtonensis
9122	X16	E8	.13		H. lambtonensis
9122	X18	E8	.10		H. lambtonensis
9123	X21*	E9	.13		H. lambtonensis
9124	Y1	I5	.15	3	H. lambtonensis
9124	Y5	I5	.13		H. lambtonensis
9124	Y15	I7	.13		H. lambtonensis
9124	Y16	I7	.15		H. austinensis
9124	Y24	I7	.13		H. lambtonensis
9124	Y25	I7	.13		H. lambtonensis
9124	Y28	I7	.10		H. lambtonensis
9124	Y29	I7	.13		H. austinensis
9124	Y30	I7	.13		H. lambtonensis
9124	Y31	I7	.13	3	H. lambtonensis
9124	Y32	I7	.13		H. austinensis
9124	Y36*	I7	.11		H. lambtonensis
9124	Y37	I7	.13		H. austinensis
9125	Y42	I7.5	.17	4	H. lambtonensis
9125	Y43	I7.5	.13	2	H. lambtonensis
9126	Z4	I9	.13		H. lambtonensis
9126	Z8	I9	.13		H. lambtonensis
9117	AC5	H3	.15		H. lambtonensis
9125	AC6	I7.5	.10		H. lambtonensis

Characteristics of Species of Neoprioniodus

UNSM #	Slide #	Loc. #	# of denticles	Spacing denticles	Length of bar (mm)	Species
9127	B30	D8				N. sp. undt frag.
9128	C41	D13	3 + main	variable	.45	N. idoneus
9128	C47	D13	2 + main	2 close but var.	.40	N. idoneus
9129	E48	D18	6 + main	variable	.60	N. idoneus
9130	G24	D24	2 + main	wide	.80	N. sp. A*
9131	H15	D25	3 + main	all narrow	.37	N. idoneus
9132	H45	D28	1 main		.35	N. idoneus
9133	H56	D29	1 main	all narrow	.40	N. sp. A
9134	I32	D35	1 + main	all narrow	.45	N. sp. A
9135	K37	R8	1 + main	all narrow	.45	N. idoneus
9135	K43	R8	3 + main	narrow and close	.37	N. sp. A
9136	M10	R15	7 + main	set together	.70	N. idoneus*
9137	M49	R17	7 + main	set together	.70	N. idoneus
9138	N41	R21	6 + main	variable	.50	N. idoneus
9138	N42	R21	1 main			N. idoneus
9138	N48	R21	2 + main	variable	.35	N. idoneus
9139	O25	R23	1 main		.37	N. spundt.
9140	O50	R24	1 + main	variable	.35	N. idoneus
9141	S20	R37	4 + main	variable	.45	N. idoneus
9142	V5	Q12	6 + main	variable	.60	N. idoneus
9143	W45	E4	6 + main	variable	.65	N. idoneus*
9144	W56	E5	4 + main	variable	.67	N. idoneus*
9145	X14	E8	3 + main	variable	.50	N. idoneus
9146	X59	I5	1 + main	variable	.35	N. idoneus
9147	Y45	I7.5	3 + 1 main	narrow	.40	N. idoneus
9148	Y55	I8	1 + 1 main	wide	.35	N. idoneus
9149	AC4	H6	4 + 1 main	variable	.45	N. idoneus

Characteristics and Species of Polygnathus

UNSM #	Slide #	Loc. #	Length (mm)	Species
9150	A49	D4	----	P. sp. frag.
9151	B5	D5	1.38	P. linguiformis
9152	B14	D6	----	P. sp. frag.
9153	B28	D7	.60	P. linguiformis frag.
9154	B29	D8	1.03	P. linguiformis
9154	B47	D8	.80	P. linguiformis frag.
9154	B51	D8	.70	P. linguiformis frag.
9155	B57	D10	.70	P. linguiformis frag.
9156	C2	D11	.75	P. linguiformis frag.
9156	C3	D11	.63	P. linguiformis frag.
9156	C5	D11	1.00	P. linguiformis frag.
9156	C7	D11	1.05	P. linguiformis
9156	C9	D11	.47	P. linguiformis
9157	C13	D13	1.20	P. linguiformis frag.
9157	C32	D13	1.52	P. linguiformis
9157	C49	D13	.65	P. linguiformis
9157	C50	D13	1.20	P. linguiformis frag.
9157	C55	D13	1.00	P. linguiformis frag.
9157	D8	D13	.57	P. linguiformis frag.
9157	D9	D13	.63	P. linguiformis frag.
9157	D19	D13	.99	P. linguiformis frag.
9157	D24	D13	.50	P. linguiformis frag.
9158	D28	D15	.75	P. linguiformis
9158	D30	D15	1.00	P. linguiformis
9158	D32	D15	1.50	P. linguiformis
9159	D41	D16.5	1.25	P. linguiformis
9160	D51	D17	.60	P. linguiformis
9160	D53	D17	.68	P. linguiformis
9161	E25	D18	.50	P. linguiformis frag.
9161	E28	D18	1.20	P. linguiformis frag.
9161	F11	D18	.52	P. sp. frag.
9162	H48	D28	.75	P. sp.
9163	I12	D33	.15	P. sp. frag.
9164	I56	D37	.60	P. sp. frag.
9165	J25	D40	.61	P. sp. frag.
9166	K3	R3	.82	P. linguiformis frag.
9166	K8	R3	.50	P. linguiformis frag.
9167	K14	R3.5	1.00	P. linguiformis frag.
9168	K32	R8	.50	P. sp. frag.
9168	K44	R8	.62	P. linguiformis frag.
9169	L8	R9	.55	P. sp. frag.
9169	L10	R9	.65	P. sp. frag.
9169	L15	R9	.85	P. sp.
9170	L18	R10	.50	P. sp. frag.
9170	L27	R10	.42	P. sp. frag.

UNSM #	Slide #	Loc. #	Length (mm)	Species
9170	L28	R10	.40	P. linguiformis frag.
9171	L35	R14	1.30	P. linguiformis frag.
9171	L36	R14	.65	P. linguiformis frag.
9171	L37	R14	1.15	P. linguiformis frag.
9171	L38	R14	1.50	P. linguiformis frag.
9171	L39	R14	.40	P. sp. frag.
9171	L42	R14	.60	P. linguiformis frag.
9171	L49	R14	.65	P. sp. frag.
9171	M2	R14	.40	P. linguiformis frag.
9172	M7	R15	1.20	P. linguiformis frag.
9172	M9	R15	.60	P. linguiformis frag.
9172	M13	R15	.75	P. linguiformis
9173	M16	R15.6	.40	P. linguiformis frag.
9173	M21	R15.6	.90	P. linguiformis
9173	M22	R15.6	.42	P. linguiformis frag.
9174	M48	R17	.40	P. sp. frag.
9175	M52	R19	1.15	P. linguiformis ? frag.
9176	M60	R20	.15	P. sp. frag.
9176	N3	R20	1.15	P. linguiformis frag.
9176	N5	R20	.95	P. linguiformis
9177	N8	R21	.90	P. linguiformis
9177	N22	R21	.65	P. linguiformis frag.
9177	N23	R21	----	P. sp. undt. frag.
9177	N34	R21	.45	P. linguiformis ? frag.
9177	N35	R21	.60	P. sp.
9177	N44	R21	.55	P. sp. frag.
9178	N53	R22	1.02	P. linguiformis ? frag.
9178	N55	R22	.97	P. linguiformis frag.
9179	O34	R24	.55	P. sp. frag.
9179	O35	R24	.55	P. sp. frag.
9179	O45	R24	.78	P. linguiformis frag.
9179	O46	R24	1.00	P. linguiformis frag.
9179	O55	R24	.65	P. linguiformis frag.
9179	O57	R24	.80	P. linguiformis frag.
9180	P4	R26	.97	P. linguiformis frag.
9180	P7	R26	.62	P. linguiformis frag.
9180	P17	R26	.65	P. linguiformis frag.
9180	P18	R26	.60	P. sp. frag.
9180	P29	R26	.85	P. linguiformis frag.
9180	P37	R26	.65	P. linguiformis frag.
9180	P39	R26	.62	P. linguiformis frag.
9180	P49	R26	.55	P. linguiformis frag.
9180	P50	R26	.35	P. linguiformis frag.
9180	P54	R26	.45	P. linguiformis frag.
9180	P58	R26	.85	P. linguiformis
9180	P59	R26	.85	P. linguiformis frag.
9180	P60	R26	.65	P. linguiformis
9181	Q24	R31	.70	P. sp.
9182	R42	R35	.50	P. sp. undt. ? frag.
9182	R45	R35	.51	P. linguiformis frag.

UNSM #	Slide #	Loc. #	Length (mm)	Species
9182	S2	R35	.75	P. linguiformis frag.
9183	S11	R36	.85	P. linguiformis
9183	S13	R36	1.20	P. linguiformis
9183	S14	R36	.70	P. sp.
9184	S18	R37	.90	P. linguiformis frag.
9185	T2	G0	1.40	P. linguiformis
9186	T3	G1	1.40	P. linguiformis
9186	T7	G1	.74	P. linguiformis
9186	T9	G1	.37	P. linguiformis frag.
9186	T18	G1	.75	P. linguiformis frag.
9187	T21	G2	.75	P. linguiformis frag.
9187	T22	G2	1.20	P. linguiformis frag.
9188	T43	G3	.25	P. sp. undt. frag.
9188	T36	G3	.75	P. linguiformis
9188	T37	G3	.50	P. linguiformis frag.
9188	T48	G3	1.00	P. linguiformis frag.
9188	T49	G3	.95	P. linguiformis frag.
9188	T51	G3	.50	P. linguiformis ? frag.
9188	T53	G3	.50	P. sp. frag.
9189	T56	G4	1.25	P. linguiformis
9190	U7	G5	.42	P. sp. undt. frag.
9191	U16	S1	1.40	P. linguiformis frag.
9192	U28	P1	.65	P. linguiformis frag.
9193	U39	P2	.45	P. sp. undt. frag.
9193	U42	P2	.45	P. sp. undt. frag.
9194	U44	P3	.40	P. sp. frag.
9194	U46	P3	.45	P. sp. undt. frag.
9195	U51	P4	.77	P. linguiformis ? frag.
9196	V7	012	.80	P. linguiformis frag.
9197	V15	021	1.25	P. linguiformis
9198	V24	021.5	.53	P. sp. frag.
9199	V30	025	.63	P. linguiformis frag.
9200	V32	026	.82	P. linguiformis ? frag.
9201	V34	027	.49	P. sp. frag.
9202	V39	028	1.36	P. linguiformis
9203	V41	029		P. sp. undt. frag.
9204	V42	029	.85	P. linguiformis frag.
9204	V43	029	.95	P. linguiformis frag.
9204	V49	029	1.15	P. linguiformis frag.
9205	W1	B0	1.17	P. linguiformis
9205	W3	B0	1.10	P. linguiformis
9206	W11	H1	.57	P. linguiformis frag.
9207	W16	H2.5	.90	P. linguiformis ? frag.
9208	W20			P. sp. undt. frag.
9208	W21	H3	.67	P. linguiformis frag.
9209	W23	H4	.91	P. linguiformis ? frag.
9210	W28	H5	.60	P. linguiformis frag.
9211	W31	H7	1.10	P. linguiformis frag.
9212	W40	E2	1.70	P. linguiformis frag.

UNSM #	Slide #	Loc. #	Length	Species
9213	W44	E4	.75	P. linguiformis frag.
9214	X3	E6	.65	P. linguiformis frag.
9214	X5	E6	.51	P. linguiformis frag.
9215	X11	E7	.65	P. linguiformis frag.
9215	X12	E7	.84	P. linguiformis frag.
9216	X19	E9	.70	P. sp. frag.
9217	X41	I3	1.25	P. linguiformis ? frag.
9217	X48	I3	.65	P. linguiformis frag.
9217	X49	I3	.63	P. linguiformis ? frag.
9217	X50	I3	1.00	P. linguiformis
9218	X52	I4	1.50	P. linguiformis frag.
9218	X53	I4	1.50	P. linguiformis frag.
9218	X54	I4	1.05	P. linguiformis frag.
9218	X57	I4	.95	P. linguiformis
9218	X60	I4	1.30	P. linguiformis
9219	Y12	I6	.30	P. linguiformis frag.
9220	Y14	I7	.80	P. linguiformis ? frag.
9220	Y21	I7	1.00	P. linguiformis
9220	Y35	I7	1.25	P. linguiformis
9220	Y39	I7	.75	P. linguiformis ? frag.
9220	Y40	I7	1.00	P. linguiformis ? frag.
9221	Y46	I7.5	1.10	P. linguiformis frag.
9221	Y47	I7.5	1.51	P. linguiformis frag.
9222	Y58	I9	.75	P. linguiformis ? frag.
9222	Z1	I9	.65	P. sp. undt. frag.
9222	Z6	I9	.52	P. linguiformis frag.
9222	Z7	I9	1.10	P. linguiformis
9223	Z10	I10	.63	P. linguiformis frag.
9223	Z11	I10	1.30	P. linguiformis
9223	Z12	I10	.53	P. sp. frag.
9223	Z13	I10	.55	P. sp. undt. frag.
9224	Z58	J11	.63	P. linguiformis frag.
9225	AA3	L1	1.25	P. linguiformis
9226	AA4	L3	.75	P. linguiformis ? frag.
9227	AA9	L6		P. sp. undt. frag.
9228	AA12	L7	.85	P. linguiformis frag.
9228	AA13	L7	.65	P. linguiformis ? frag.
9228	AA14	L7	.87	P. linguiformis
9229	AC1	E5	.70	P. linguiformis
9230	AC2	J2	1.00	P. linguiformis ? frag.
9231	AC3	I5	1.02	P. linguiformis frag.

Measurements and Species of Icriodus

UNSM #	Slide #	Loc. #	Length (mm)	Species
9232	B26	D7	.45	I. nodosus ?
9233	B42	D8	.45	I. cymbiformis
9233	B50	D8	.65	I. angustus
9234	C27	D13	.52	I. angustus
9234	C60	D13	.67	I. nodosus
9234	D10	D13	.60	I. expansus ?
9234	D12	D13	.52	I. nodosus ?
9234	D27	D13	.70	I. nodosus
9235	D29	D15	.73	I. nodosus
9235	D37	D15	.68	I. nodosus
9236	E15	D18	.60	I. expansus ?
9236	E16	D18	.65	I. expansus ?
9236	E19	D18	.50	I. cymbiformis
9236	E21	D18	.35	I. cymbiformis
9236	E43	D18	.30	I. cymbiformis
9236	E49	D18	.70	I. nodosus
9236	E56	D18	.52	I. expansus ?
9236	F14	D18	.40	I. cymbiformis
9236	F17	D18	.45	I. expansus ?
9236	F20	D18	.40	I. cymbiformis frag.
9236	F24	D18	.38	I. cymbiformis
9237	F45	D23	.60	I. nodosus
9238	G37	D25	.77	I. nodosus
9238	G39	D25	.70	I. nodosus
9238	G44	D25	.65	I. expansus ?
9238	G45	D25	.50	I. expansus ?
9238	G46	D25	.30	I. cymbiformis
9238	G47	D25	.50	I. expansus ?
9238	G48	D25	.55	I. expansus ?
9238	G49	D25	.55	I. expansus ?
9238	G53	D25	.60	I. expansus ?
9238	G56	D25	.70	I. nodosus
9238	G58	D25	.50	I. expansus?
9238	G59	D25	.55	I. expansus ?
9238	H7	D25	.42	I. cymbiformis
9238	H12	D25	.53	I. expansus ?
9238	H13	D25	.47	I. cymbiformis
9238	H16	D25	.52	I. expansus ? frag.
9239	H31	D26	.60	I. expansus
9240	H38	D28	.35	I. sp. undt.
9240	H42	D28	.50	I. expansus?
9241	H58	D29	.50	I. angustus
9242	I14	D34	.30	I. cymbiformis
9243	I20	D35	.60	I. nodosus
9243	I26	D35	.35	I. cymbiformis
9243	I29	D35	.50	I. expansus ? frag.

UNSM #	Slide #	Loc. #	Length (mm)	Species
9243	I33	D35	.55	I. expansus ? frag.
9243	I34	D35	.30	I. cymbiformis
9243	I36	D35	.50	I. cymbiformis
9243	I37	D35	.60	I. nodosus frag.
9244	I51	D36	.58	I. expansus ?
9245	J11	D40	.77	I. nodosus
9245	J16	D40	.32	I. cymbiformis
9245	J24	D40	.62	I. expansus ?
9245	J26	D40	.50	I. angustus
9245	J27	D40	.25	I. cymbiformis frag.
9246	J29	D41	.50	I. nodosus
9246	J30	D41	.53	I. expansus ?
9247	J57	R2	.50	I. expansus ?
9248	K18	R4	.35	I. cymbiformis
9249	K26	R5	.50	I. nodosus
9250	K27	R8	.60	I. expansus ?
9250	K42	R8	.62	I. nodosus frag.
9251	K60	R9	.30	I. nodosus ? frag.
9251	L16	R9	.70	I. nodosus
9252	L40	R14	.45	I. cymbiformis
9252	L53	R14	.42	I. cymbiformis
9253	M20	R15.6	.77	I. nodosus
9254	M25	R16	.77	I. nodosus
9254	M30	R16	.70	I. nodosus
9254	M40	R16	.55	I. expansus ?
9255	M45	R17	.52	I. expansus ? frag.
9256	M51	R19	.70	I. nodosus
9257	N6	R20	.70	I. nodosus
9258	N45	R21	.35	I. cymbiformis
9258	N46	R21	.42	I. cymbiformis frag.
9258	02	R22	.61	I. expansus ?
9259	014	R23	.55	I. expansus ?
9260	052	R24	.62	I. nodosus
9260	053	R24	.52	I. expansus ?
9260	054	R24	.35	I. expansus ? frag.
9260	058	R24	.67	I. nodosus
9260	060	R24	.75	I. nodosus
9261	P34	R26	.46	I. cymbiformis
9261	P41	R26	.60	I. cymbiformis frag.
9261	P46	R26	.35	I. expansus ? frag.
9261	Q3	R26	.60	I. expansus ?
9262	Q31	R32	.40	I. cymbiformis
9263	Q48	R33	.65	I. nodosus
9263	Q52	R33	.52	I. expansus ?
9263	Q55	R33	.50	I. nodosus ?
9264	R5	R34	.46	I. cymbiformis
9264	R18	R34	.72	I. nodosus
9264	R30	R34	.25	I. cymbiformis frag.
9265	R60	R35	.60	I. expansus ?

UNSM #	Slide #	Loc. #	Length (mm)	Species
9266	S7	R36	.55	I. expansus ?
9266	S9	R36	.45	I. nodosus ? frag.
9267	S41	R40	.78	I. nodosus
9268	S46	R41	.53	I. expansus ?
9268	S50	R41	.37	I. nodosus ? frag.
9269	T34	G3	.40	I. nodosus ? frag.
9269	T39	G3	.40	I. nodosus ? frag.
9269	T45	G3	.50	I. nodosus
9270	V2	G4	.72	I. nodosus
9271	V36	P2	.52	I. expansus ?
9271	V38	P2	.62	I. nodosus
9272	V48	029	.77	I. nodosus
9273	W42	E4	.64	I. expansus ?
9273	W46	E4	.52	I. expansus
9273	W51	E4	.40	I. nodosus ? frag.
9273	W52	E4	.49	I. cymbiformis
9274	X4	E6	.52	I. expansus ?
9275	X13	E8	.65	I. angustus
9275	X15	E8	.62	I. expansus ?
9275	X17	E8	.35	I. cymbiformis ? frag.
9276	X20	E9	.52	I. expansus ?
9277	X39	I0	.70	I. nodosus
9278	Y10	I6	.60	I. nodosus frag.
9279	Y38	I7	.73	I. nodosus
9280	Y50	I7.5	.40	I. undt. frag.
9281	Z2	I9	.65	I. nodosus
9281	Z48	J9	.67	I. expansus ?
9281	Z49	J9	.65	I. expansus ?
9281	Z50	J9	.40	I. cymbiformis
9282	AA23	M4.5	.52	I. nodosus
9282	AA24	M4.5	.78	I. latericrescens
9282	AA25	M4.5	.50	I. latericrescens frag.
9282	AA26	M4.5	1.00	I. latericrescens frag.
9283	AA37	M13	.87	I. latericrescens
9283	AA38	M13	.60	I. latericrescens
9282	AA53	M4.5	.62	I. latericrescens frag.
9282	AA56	M4.5	.80	I. latericrescens frag.

Characteristics of Lonchodus

UNSM #	Slide #	Loc. #	# of denticles	Spacing denticles (mm)	Width bar (mm)
9284	I31	D35	---	---	---
9285	I45	D36	2	.25	.10
9286	R4	R34	---	---	---
9287	R36	R35	4	.20	.08
9287	R37	R35	2	.20	.10
9287	R38	R35	2(1)	.25	.08
9287	R39	R35	5	.23	.13
9287	R46	R35	2	.25	.13
9287	R47	R35	3	.23	.13
9287	R48	R35	3	.23	.10
9287	R52	R35	1	---	.10
9287	R53	R35	5	.20	.15
9287	R54	R35	2	.23	.08
9287	R55	R35	4(3)	.23	---
9287	R57	R35	6	.20	.08
9287	S4	R35	2	.20	.08
9287	S5	R35	3	.18	.08
9288	S36	R39	2	.27	.10

PHYLUM MOLLUSCA

Tentaculites Measurements

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)
9289	B3	D5	1.20	.60
9290	M59	R20	1.40	.25
9291	U18	S2	1.00	.35

Macrofaunal Distribution

Phylum	Species	Locality	# Feet Above Base	UNSM #
Porifera	Clionolithes sp.	85791	11	9292
Coelenterata ?	Stromatoporella sp.	85801	2-3	9293
	Syringostroma sp.	85801	2-3	9294
Coelenterata	Asthenophyllum ? sp.	85795	1	9295
		85789	3	9296
		85802	11	9297
	Heterophrentis inflata	85791	1	9298
		85793	10	9299
		85801	2	9300
	Heterophrentis ? sp.	85792	11	9301
		85793	10	9302
		85795	1	9303
		85798	0,4.5,7,11	9304-07
		85801	19	9308
		85802	21	9309
	Heliophyllum halli	85801	2,3-5	9310-11
		85802	5	9312
		85806	7	9313
	Heliophyllum sp. ?	85806	12	9314
	Acinophyllum cf. A. stramineum	85804	1.4	9315
	Acinophyllum sp. ?	85806	8	9316
	Hexagonaria truncata	85801	2	9317
	Cystiphylloides cf. C. americanum	85794	5	9318
	Edaphophyllum cf. E. bifurcatum	85793	1	9319
		85801	11	9320
		85802	19	9320
	Chaetetes sp. ?	85801	2	9321
	Favosites sp. ?	85789	3	9322
		85801	2	9323
		85803	1	9324
		85806	6	9325
	Cladopora sp. ?	85801	3-5	9326
		85806	1	9327

Bryozoa	Fistulipora cf. F. ponderosa	85801	2	9328
	Fenestella cf. F. sylvia	85800	2	9329
		85801	2	9330
		85802	18	9331
		85804	1	9332
		85807	1	9333
	Polypora cf. Fenestella (P) robusta	85800	1	9334
		85801	2	9335
		85802	7	9336
	Orthopora cf. O. bispinulata	85801	35	9337
	Sulcoretepora gilberti	85789	2,3	9338-39
		85790	3,4,5	9340-42
		85800	2	9343
		85801	2,3,4	9344-46
		85802	5,7,16	9347-49
		85807	1	9350
Brachiopoda	Lingula sp.	85795	2	9351
		85801	2	9352
	Craniops hamiltoniae	85792	11	9353
		85801	2	9354
	Schizophoria multistriata	85793	26	9355
		85794	7	9356
		85795	4	9357
		85801	10	9358
		85803	1	9359
		85804	2,8	9360-61
	Rhipidomella cf. R. cyclas	85790	1	9362
		85793	22	9363
		85802	15	9364
	Leptaena rhomboidalis	85789	1,11	9365-66
		85793	25	9367
		85795	1	9368
		85797	3	9369
		85798	6	9370
		85801	2,18	9371-72
		85802	17	9373
		85804	1	9374
	Strophodonta demissa	85801	18	9375
		85803	1	9376
	Megastrophia concava	85789	5	9377
		85794	8	9378
		85795	3	9379
		85798	6	9380
		85801	2,40	9381-82
		85803	0	9383
		85804	0	9384

Protoleptostrophia cf. P. perplana	85792	3.5	9385
	85797	2	9386
	85798	4	9387
	85801	2	9388
	85802	15,17	9389-90
	85804	1	9391
Longispina deflectus	85798	0,1,2,3	9392-95
	85801	36-44	9396-404
	85802	36-41	9405-10
"Chonetes" sp.	85789	1	9411
	85790	2	9412
	85791	8	9413
	85793	27	9414
	85799	4	9415
	85801	2	9416
	85802	17	9417
Pentamerella arata	85795	10	9418
Camarotoechia sappho	85795	2	9419
	85801	13	9420
Atrypa reticularis	85789	1,2.5	9421-22
	85790	3,6	9423-24
	85793	25	9425
	85794	5	9426
	85795	3	9427
	85797	3	9428
	85801	2	9429
	85802	17	9430
	85803	0	9431
	85804	1	9432
	85807	1	9433
Spinatrypa spinosa	85789	1	9434
	85790	2	9435
	85791	2	9436
	85793	28	9437
	85794	8	9438
	85795	3	9439
	85797	2,3	9440-41
	85800	3,4	9442-43
	85801	2	9444
	85802	16	9445
	85803	0	9446
	85804	1	9447
	85806	15	9448
	85807	1	9449
Nucleospira concinna	85789	5	9450
	85790	6	9451
	85791	5,7	9452-53
	85792	4,5	9454-55
	85793	27,28	9456-57
	85794	5	9458
	85795	2,3	9459-60
	85797	3	9461
	85801	20	9462

	Cyrtina umbonata var. alpeaensis	85789	5	9463
		85793	3	9464
		85797	3	9465
	Cyrtina hamiltonensis	85789	5	9466
		85790	4,5	9467-68
		85791	6,8	9469-70
		85792	5,7,8	9471-73
		85795	29	9474
		85795	1,2,3	9475-77
		85797	2	9478
	Delthyris raricosta	85802	19	9479
		85804	1	9480
	Brevispirifer lucasensis	85789	1	9481
		85790	5,6	9482-83
		85791	5	9484
		85792	12	9485
		85793	29	9486
		85794	6	9487
		85795	5	9488
		85797	2	9489
		85798	9	9490
		85801	18	9491
		85802	23	9492
		85803	1	9493
		85804	1	9494
		85806	15	9495
		85807	1	9496
	"Spirifer" marcrus	85803	1	9497
		85804	2.5	9498
		85806	10	9499
	Martiniopsis ? maia	85801	2,40	9500-01a-e
	Martiniopsis sp.	85801	3	9502
	"Spirifer" cf. "S" duodenarius	85798	8.5	9503
	"Spirifer" sp. A	85803	1	9504
Mollusca				
Pelecypoda	Solemya (Janeia) vetusta	85801	18	9505
		85802	16	9506
	Paracyclas cf. P. elliptica	85795	3	9507
		85803	1	9508
	Cypricardina cf. C. consimilis	85795	2.5	9509
	Conocardium cuneus ?	85801	2-3	9510
Gastropoda	Pleuronotus ? sp. A	85794	4	9511
		85795	3	9512
		85801	2	9513
	Pleuronotus ? sp. B	85801	35	9514
	Platyceras (Platyceras) erectum	85800	2	9515
		85801	2,18	9516-17
		85802	19	9518
Cephalopoda	Michelinoceras ? sp.	85801	2	9519

Cricoconarida				
	Tentaculites sclariformis	85793	20	9520
		85800	2	9521
		85801	2,5	9522
		85802	20	9523
	T. gracilistriatus	85793	20	9524
		85801	2	9525
Arthropoda	Dechenella (Bassidechenella) rowi	85800	1,2	9526-27
		85801	2,3,4	9528-30
		85802	3,4	9531-32
	Proetus (Crassiproetus) crassimarginatus	85789	1,7	9533
		85795	8.5	9534
		85801	2-3	9535
Echinodermata	Arachnocrinus bulbosus	85804	2	9536
	Arachnocrinus ignotus ?	85806	22	9537
Unknown	Coleolus ? sp.	85801	2	9538

Additional Invertebrates without Measurements

Drepanodus sp.

UNSM #	Slide #	Loc. #
9583	G55	D25
9584	R15	R34
9584	R26	R34
9585	S32	R39
9586	V13	018

Paltodus cf. P. bellatus

UNSM #	Slide #	Loc. #
9587	G38	D25
9588	R3	R34
9588	R9	R34

Prioniodina ? sp.

UNSM #	Slide #	Loc. #
9589	L45	R14
9589	L47	R14
9590	N36	R21
9591	056	R24
9592	P31	R26
9593	X8	E6
9594	X22	E9

Ozarkodina cf. O. congesta

UNSM #	Slide #	Loc. #
9595	B40	D8
9596	K31	R8
9597	L12	R9

Plectospathodus ? sp.

UNSM #	Slide #	Loc. #
9598	U49	P3

Bryantodus cf. *B. planus*

UNSM #	Slide #	Loc. #
9599	B31	D8
9600	M39	R16
9601	M50	R17
9602	N15	R21
9602	N16	R21
9602	N17	R21
9602	N18	R21
9602	N19	R21
9602	N29	R21
9602	N33	R21
9603	047	R24
9604	P42	R26
9605	S17	R36

Hibardella ? sp.

UNSM #	Slide #	Loc. #
9605	A41	D4
9607	H30	D26
9608	U59	Q4

Lonchodina ? sp.

UNSM #	Slide #	Loc. #
9609	D2	D13
9610	G57	D25
9610	G60	D25
9611	H27	D26
9612	I16	D34
9613	022	R23
9613	024	R23
9614	P30	R26
9614	P36	R26
9615	U22	S3

Protocaudina kansasensis

UNSM #	Slide #	Loc #
9616	A50	D4
9617	A58	D5
9618	B13	D6
9619	E47	D18
9620	K7	R3
9621	L5	R9
9622	L20	R10
9623	T27	G2
9624	T32	G3
9625	U3	G4
9626	U6	G5
9627	U20	S4
9628	V4	Q12
9629	V31	026
9629	V33	026
9630	V40	029
9630	V47	029
9631	W26	H5
9632	Y20	I7
9632	Y54	I8
9632	Z46	J8
9633	AA21	H1

Spinulicosta spinulicosta

UNSM #	Loc #	# Specimens
9634	D18	2

PHYLUM CHORDATA

Characteristics of *Ohioaspis lamellatus*

UNSM #	Slide #	Loc. #	Dimensions	Tubercles	Other characteristics
75200	H29	D26	.40 x .35	1	front of tubercle flattened; back rounded
75201	J28	D41	.25 x .25	1	
75202	J56	R2	.50 x .35	1	definitely like D26 above

Characteristics of *O. tumulosus*

UNSM #	Slide #	Loc. #	Maximum, Minimum Dimension (mm)	Tubercles	Shape
75203	B59	D11	1.15 x .95	10	oval
75204	D26	D13	.80 x .55	17+	oval
75205	E51	D18	.35 x .32	1	
75206	J15	D40	.45 x .42	1	
75206	J18	D40	.45 x .43	1	
75207	Q22	R29	.90 x .65	6	oval
75208	Q23	R31	.90 x .65	3	oval
75209	AA52(14)	M4.5	1.15 x .75	1	oval
75209	AA55	M4.5	.75 x .65	6	oval
75210	V21	O21	.50 x .25	6	

Characteristics of *O. stewartae*

UNSM #	Slide #	Loc. #	W (mm)	L (mm)	Tubercles	Other Information
75211	A30	D3	.65	.30	5	Base flat, rect., gray
75212	B18	D7	.25	.23	2	Base flat, (frag) rect., gray
75213	D3	D13	.40	.17	4	Base flat, rect., gray
75214	E14	D18	.50	.30	5	Base flat, rounded, orange
75214	E46	D18	.50	.25	4	Base flat, rect., white
75215	G30	D25	.25	.85	5	Pointed spines, base flat, irreg., white
75215	G54	D25	.90	.40	6	Base flat, (frag) rect., gray
75215	H8	D25	.50	.30	2	Base flat, rect., brown
75216	I49	D36	.60	.40	3	Base flat, rect., brown
75217	S26	R38	.75	.45	1	Base flat, (frag) irreg., brown
75218	S43	R40	.40	.30	4	Base flat, irreg., orange
75219	S60	R41	.45	.45	3	Base irreg., rect., white
75220	X34	C1	.35	.35	2	Base flat (frag) rounded, white

Characteristics of *Plectrodus aculeatus* ?

UNSM #	Slide #	Loc. #	Maximum, Minimum Dimension (mm)	Other Information
75221	K48	R8	.55 x .35	3 tubercles central one is smallest, base flat
75222	06	R22	.50 x .40	3 tubercles, base flat
75223	W5	B0	.50 x .40	3 tubercles in row, base flat

Important Characteristics of Acanthoides dublinensis

UNSM #	Slide #	Loc. #	L (mm)	W (mm)	Other Information
75224	A31	D3	.50	.45	Brown, rounded base, smooth crown
75225	A47	D4	.40	.40	Brown, rounded base, smooth crown
75226	A54	D4	.40	.30	Brown, rounded base, smooth crown
75227	B55	D10	.50	.42	Brown, rounded base, smooth crown
75228	B58	D11	.60	.50	Brown, rounded base, smooth crown
75229	C22	D13	.50	.45	Brown, rounded base, smooth crown
75230	D40	D15	.60	.55	Gray, rounded base, smooth crown
75231	E18	D18	.40	.30	Black, rounded base, smooth crown
75231	E20	D18	.40	.40	Brown, rounded base, smooth crown
75231	E26	D18	.25	.25	Red, rounded base, smooth crown
75231	E27	D18	.80	.67	Yellow, rounded base, smooth crown
75231	E30	D18	.40	.40	White, rounded base, smooth crown
75231	F12	D18	.40	.25	Brown, rounded base, smooth crown
75231	F15	D18	.40	.30	Brown, rounded base, smooth crown
75232	G1	D24	.45	.49	Brown, rounded base, smooth crown
75232	G8	D24	.45	.43	Brown, rounded base, smooth crown
75232	G9	D24	.30	.30	Gray, rounded base, smooth crown
75232	G10	D24	.35	.25	Gray, rounded base, smooth crown
75232	G11	D24	.35	.20	Gray, rounded base, smooth crown
75232	G14	D24	.40	.35	Gray, rounded base, smooth crown
75232	G20	D24	.60	.60	Gray, rounded base, smooth crown
75232	G29	D24	.65	.65	Gray, rounded base, smooth crown
75233	G32	D25	.50	.50	Gray, rounded base, smooth crown
75233	G33	D25	.45	.45	Gray, rounded base, smooth crown
75233	G34	D25	.65	.63	Gray, rounded base, smooth crown
75233	G35	D25	.75	.55	Gray, rounded base, smooth crown
75233	G40	D25	.55	.52	Gray, rounded base, smooth crown
75233	G41	D25	.50	.49	Gray, rounded base, smooth crown
75233	G50	D25	.55	.30	Gray, (frag) rounded base, smooth crown
75234	H19	D26	.42	.50	Gray, (frag) rounded base, smooth crown
75235	H33	D28	.50	.45	Gray, rounded base, smooth crown
75236	I31	D35	.45	.50	Gray, rounded base, smooth crown
75236	I40	D35	.40	.45	Gray, (frag) rounded base, smooth crown
75237	J41	D44	.45	.37	Gray, rounded base, smooth crown
75238	J51	R2	.35	.40	Gray, (frag) rounded base, smooth crown
75239	K29	R8	.32	.32	Gray, rounded base, smooth crown
75240	M29	R15.6	.65	.63	Gray, rounded base, smooth crown
75241	N1	R20	.60	.58	Gray, rounded base, smooth crown
75242	N30	R21	.30	.25	Gray, rounded base, smooth crown
75242	N31	R21	.50	.40	Brown, rounded base, smooth crown
75242	N32	R21	.65	.55	Brown, rounded base, smooth crown
75242	N50	R21	.50	.50	Gray, rounded base, smooth crown
75243	033	R24	.40	.30	Gray, rounded base, smooth crown
75243	048	R24	.55	.53	Gray, rounded base, smooth crown
75244	Q5	R27	.50	.30	Gray, rounded base, smooth crown
75244	Q9	R27	.40	.42	Gray, rounded base, smooth crown
75245	Q19	R28	.65	.65	Gray, rounded base, smooth crown

UNSM #	Slide #	Loc. #	L (mm)	W (mm)	Other Information
75245	Q19	R28	.65	.65	Gray, rounded base, smooth crown
75246	Q26	R31	.55	.60	Gray, rounded base, smooth crown
75247	Q38	R33	.35	.55	Gray, rounded base, smooth crown
75247	Q45	R33	.37	.30	Gray, rounded base, smooth crown
75247	Q50	R33	.45	.35	Gray, rounded base, smooth crown
75248	R2	R34	.50	.50	White, rounded base, smooth crown
75249	R41	R35	.40	.25	Gray, rounded base, smooth crown
75250	S24	R37	.65	.55	Brown, rounded base, smooth crown
75251	S28	R38	.45	.40	Brown, rounded base, smooth crown
75252	S56	R41	.50	.35	Gray, rounded base, smooth crown
75253	X32	C1	.32	.20	Gray, rounded base, smooth crown

<u>Acanthoides hardyi Measurements</u>

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)
75254	E7	D18	1.35	.83
75255	U54	P4	.95	.65

Characteristics of <u>A. sciotoensis</u>

UNSM #	Slide #	Loc. #	L (mm)	W (mm)	Other Information
75256	R24	D1	1.10	.50	Brown, smooth, rhombic
75257	B24	D7	.85	.45	Brown, smooth, rhombic, slightly rounding
75258	G52	D25	1.00	.55	Gray, smooth, elongate frag.
75259	I55	D37	.51	.35	Tan, smooth, rhombic
75260	Q14	R28	.45	.25	Gray, base rhombic flat, top smooth
75261	V16	021	.60	.30	Gray, base rhombic flat, top smooth
75262	X23	E9	.45	.30	White, base rhombic flat, top smooth
75263	Y52	I8	.35	.25	Brown, smooth, rhombic

Characteristics of Cheiracanthoides comis

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)	# ridges	Color
75264	A34	D3	.32	.50	4	Brown
75264	A37	D3	.75	1.00	9	Brown
75265	A59	D5	.50	.50	4	Gray
75266	B33	D8	.37	.30	7	Gray
75267	C43	D13	.60	.50	5	Gray
75268	D42	D16.5	.60	.60	5	Yellow-brown
75269	D52	D17	.50		5	Brown
75270	P22	R26	.75	.85	6	Gray
75270	P33	R26	.55	.60	8	Gray
75271	S19	R37	.50	.50	5	Brown
75272	AA45	F1	.75	.65	4	White

Characteristics of C. comptus

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)	# ridges	Color
75273	A27	D3	?	.60	7?	Yellow
75273	A28	D3	?	.50	?	Brown
75273	A29	D3	.55	.65	9	Yellow
75273	A32	D3	.57	.45	6	Yellow
75273	A33	D3	.87	.65	?	Yellow
75273	A34	D3	.30 (broken)	.50	5	Brown
75274	A14	D4	.43 (broken)	.50	8+	Gray
75274	A56	D4	?	?	3+	Yellow
75275	B2	D5	.50	.50	5+?	White-brown
75276	B12	D6	.35	?	?	Brown
75277	B16	D7	.55+	1.25	9	Yellow
75277	B20	D7	?	?	?	White
75277	B21	D7	.50+	.45+	7	Yellow
75277	B22	D7	.50+	.55	7	Yellow-brown
75278	B36	D8	?	.60	5	Brown
75278	B49	D8	.50	.40	7	Gray
75278	B52	D8	.65	.40+	5+	Red-white
75278	B53	D8	?	?	3+	Yellow-black
75279	B60	D11	?	?	3+	Gray
75279	C11	D11	.65+	?	3+	Gray
75280	C20	D13	.25+	.40	5	Gray
75280	C24	D13	.25	.30	5	Gray
75280	C42	D13	.40	.40	4+	Gray
75280	D14	D13	.45	.35	5?	Gray

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)	# ridges	Color
75280	D15	D13	?	?	?	Gray
75280	D20	D13	.45	?	4?	Gray
75280	D22	D13	.60	.50	5	White
75281	D31	D15	.80	.70	7	Gray
75281	D33	D15	?	?	?	Gray
75281	D36	D15	?	.50	5	Gray
75282	D46	D16.5	.60	.65	5	Yellow-brown
75282	D47	D16.5	.55+	.70	6	Yellow-brown
75282	D48	D16.5	.50	.50	5	Yellow-brown
75283	D54	D17	.40	.30	5	Gray
75283	D55	D17	.55	.60	?	Gray
75283	D57	D17	.50	.45	5	Yellow-brown
75283	D58	D17	.85	.65	7	Gray
75283	D59	D17	.50	.40	5?	Gray
75284	E2	D18	.75	1.00	9	Yellow-brown
75284	E3	D18	.75	.63	6	Brown
75284	E13	D18	.25+	.40	5	Brown
75284	E23	D18	.30+	.40	5	Brown
75284	E24	D18	.75+	.80	13	Yellow-brown
75284	E29	D18	.50	.60	3+	Yellow-brown
75284	E31	D18	.45	.48	5	Yellow-brown
75284	E40	D18	.50+	.40+	4+	Yellow-brown
75284	E50	D18	.20	.20	4	Yellow-brown
75284	E54	D18	.55	.65	6	Brown
75284	F8	D18	.40+	.50	8	Brown
75284	F10	D18	.30	.40	4	Brown
75284	F22	D18	.40+	.60	7	Yellow
75285	F27	D19	undt. frag.			
75285	F28	D19	.40+	.60	3+	Gray
75285	F30	D19	.40	.40	6	White
75285	F31	D19	.35	.25	3+	Brown to White
75285	F32	D19	.35	.30	6	Brown
75285	F34	D19	.65	.65	6	Gray
75286	F42	D21	.35	.25	5	Gray
75287	F60	D24	.60	.50	6	Brown
75287	G5	D24	.75	.75	5	White
75287	G17	D24	.35	.45	9	Brown-gray
75287	G21	D24	.50	.50	7	Brown-gray
75287	G22	D24	.30	.35	4+	Brown-gray
75288	H20	D26	.40+	.30+	4+	Gray
75288	H26	D26	.50	.60	10	Gray
75288	H28	D26	.30+	.30	5	Brown to white
75289	H36	D28	.40+	.50	7	White
75289	H37	D28	.50+	.40+	5+	Yellow-brown
75290	H51	D29	.50+	.60	7	Brown
75291	I38	D35	.65	.65	7	Gray
75291	I41	D35	.50+	.55	9	White
75292	I44	D36	.60	.60	8	White
75292	I46	D36	.35	.25	6	White

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)	# ridges	Color
75293	J1	D37	.50+	.50+	10	White
75294	J6	D39	.50	.40	8	White
75295	J14	D40	.75+	.50+	5	Brown to White
75296	J32	D41	.40+	.35	5	White
75297	J54	R2	.65+	.65	7	Brown
75298	K16	R4	.50+	.55	7	Gray
75299	K29	R8	.65	.70	6-7	Gray
75300	L9	R9	.60	.50	6	Gray
75301	L24	R10	.35	.40	7	Gray
75302	L32	R12	.65	?	5	White
75303	L41	R14	.50	.40	5	Gray
75303	L52	R14	.70	.70	6	White-gray
75304	M17	R15.6	?	.60	6	Gray
75304	M19	R15.6	.40	.35	4+	White
75305	M32	R16	.30	.30	?	Gray
75305	M37	R16	.35	.40	4+	Gray
75305	M43	R16	.40+	.40	8?	Gray
75305	M44	R16	.40	.35	4+	Gray
75305	M47	R16	.65	.50	7	Gray
75306	M53	R20	?	?	?	Gray
75307	N20	R21	.50	.55	7	Gray
75307	N47	R21	.60	.60	7	Gray
75308	017	R23	.75+	.75	7+	White
75308	018	R23	.55	.40	4	Gray
75308	028	R23	.50+	.53	5	White
75309	037	R24	.75	.65	8	White
75309	039	R24	.90+	1.00	9	White
75310	P3	R26	1.00	.85	8	Gray
75310	P8	R26	.45	.45	5	Brown
75310	P14	R26	.65+	.90	9	Gray
75310	P15	R26	.65	.65	7	Gray
75310	P23	R26	.75	.75	6	Gray
75310	P47	R26	.40+	.50	6	Gray
75310	P47	R26	.30	.30	?	White
75311	Q8	R27	.50	.50	7	Gray
75311	Q10	R27	.50	?	5	Gray
75312	Q17	R28	.75	.75	7	White
75312	Q18	R28	.50		5	Gray
75312	Q20	R28	.75	.75	8	Gray
75312	Q21	R28	.55	.60	6	Gray
75313	Q40	R33	.45	.45	6	White
75313	Q44	R33	.37+	.40	4+	White
75314	S30	R39	.65	.55	7	Brown
75314	S31	R39	1.25	.75	7	Brown
75315	S44	R40	.35	.30	4+	Red-orange
75316	S54	R41	.60	.60	6	Gray
75317	U23	S3	.35	.22	?	White
75318	U27	P1	.65	.55	6	Brown
75319	U31	P2	.50	.50	5	Orange

UNSM #	Slide #	Loc. #	Length (mm)	Width (mm)	# ridges	Color
75319	U33	P2	.53	.53	6	White
75320	U47	P3	.75	.75	6	Orange
75321	U53	P4	.60	.50	5	Brown
75322	V14	021	?	.55	6	Gray
75322	V18	021	.55	.25	?	Brown
75323	W36	H7	1.10	.60	5+	White
75324	W38	E2	.73+	.75	6	White
75325	X6	E6	.50	.40	5	White
75325	X9	E6	.50	.50	4+	Yellow
75325	X10	E6	.65	.45	5	Yellow
75326	X33	C1	.50	.55	6	Gray
75327	Z17	I13 (worn)	1.00	.80	?	Gray
75327	Z19	I13 (worn + weathered)	.60	.60	7	Gray
75328	Z36	I18	.70	.65	?	Gray
75329	AA6	L5 (worn)	.50		5	Gray
75330	AA19	L10 (worn)	?	?	?	Gray

Characteristics of Helolepis bellarugosus

UNSM #	Slide #	Loc. #	Width (mm)	Length (mm)	# Ridges	Other Information
75331	N37	R21	.60	.60	5	Ridges only developed along anterior of corona
75332	P6	R26	.45	.45	4	Ridges only developed along anterior of corona
75333	Q16	R28	.30	.35	3	Ridges only developed along anterior of corona

Onychodus sigmoides Measurements and Dental Element Types

UNSM #	Slide #	Loc. #	Length (mm)	Part of Dent.
75334	A51	D4	.50	Laniary
75334	A52	D4	.55	Laniary
75334	A55	D4	.93	Laniary
75335	B35	D8	.60	Tooth
75335	B54	D8	.75	Interlaniary tooth
75336	C6	D11	1.50	Tooth
75337	C34	D13	.30	Tooth
75337	C46	D13	.40	Tooth
75337	C51	D13	.85	Interlaniary tooth
75337	C59	D13	.90	Interlaniary tooth
75337	D21	D13	.43	Tooth
75338	D38	D15	.35	Tooth
75339	D43	D16.5	.80	Interlaniary tooth
75340	D60	D17	.50	Interlaniary tooth
75341	E1	D18	1.10	Interlaniary tooth
75341	E12	D18	.35	Laniary
75341	E32	D18	.35	Laniary
75341	E36	D18	.70	Laniary
75341	E58	D18	.80	Laniary
75341	F1	D18	.30	Laniary
75341	F2	D18	.35	Laniary
75341	F5	D18	.30	Laniary
75342	F46	D23	.70	Laniary
75342	F53	D23	.58	Laniary
75342	F54	D23	.50	Laniary
75343	G6	D24	.45	Laniary
75344	G36(14)	D25	.90	Laniary
75344	G54	D25	.90 x .70	Scale frag.
75344	H4	D25	.53	Tooth
75344	H11	D25	.65	Tooth
75345	H22	D26	.85	Tooth
75346	H46	D28	.40	Tooth
75347	H59	D29	.87	Tooth
75347	I1	D29	.33	Tooth
75348	I8	D31	.47	Tooth
75349	I23	D35	.60	Tooth
75349	I25	D35	.80	Tooth
75350	I52	D37	1.50	Interlaniary tooth
75351	J20	D40	.50	Tooth
75352	K34	R8	.40 &.60(2 spec)	Tooth
75352	K41	R8	.40 &.60(2 spec)	Tooth
75353	K55	R9	.43	Tooth
75353	L7	R9	.40	Tooth
75354	L34	R12	.65	Tooth
75355	L51	R14	.60	Tooth
75356	M24	R15.6	1.00	Tooth
75357	N10	R21	7.90	Tooth

UNSM #	Slide #	Loc. #	Length (mm)	Part of Dent.
75357	N21	R21	.75	Tooth
75357	N38(13)	R21	.93	Interlaniary tooth
75358	01	R22	1.00	Tooth
75358	012	R22	.70	Tooth
75359	019	R23	.83	Tooth
75359	027	R23	.75	Tooth
75359	030	R23	.50	Tooth
75360	042	R24	1.75	Tooth
75360	059	R24	?	Interlaniary tooth
75361	P5	R26	.85	Tooth
75361	P31	R26	2.00	Tooth
75361	P16	R26	.40	Laniary
75361	P25	R26	.30	Tooth
75361	P26	R26	.50	Tooth
75361	P27	R26	.50	Tooth
75361	P28	R26	1.00	Tooth
75361	P44	R26	1.10	Tooth
75361	P57	R26	1.65	Tooth
75362	Q4	R27	1.15	Interlaniary tooth
75362	Q11	R27	1.25	Tooth
75362	Q13	R27	.90	Tooth
75363	Q25	R29	1.60	Tooth
75364	Q34	R33	1.25	Interlaniary tooth
75364	Q37	R33	.50	Tooth
75364	Q47	R33	.70	Tooth
75365	Q57	R34	.50	Interlaniary tooth
75365	Q59	R34	2.00	Laniary
75365	R25	R34	1.20	Interlaniary tooth
75365	R27	R34	.80	Tooth
75365	R28	R34	.98	Laniary
75366	R49	R35	1.00	Tooth
75367	S10	R36	.65	Tooth
75368	S39	R40	3.00	Tooth
75369	T60	G4	1.85	Laniary tooth
75370	V40	P2	.45	Tooth
75371	V1	Q12	.75	Tooth
75371	V2	Q12	1.20	Tooth
75372	V27	021.5	1.15	Tooth
75373	V44	029	1.50	Tooth
75373	V50	029	1.25	Tooth
75374	V55	030	.90	Tooth
75375	W2	B0	.90	Tooth
75376	X31	C1	1.60	Tooth
75376	X36	C1	.80	Tooth
75376	X37	C1	.75	Tooth
75376	X38	C1	1.40	Tooth
75377	Y3	I5	1.00	Tooth
75378	Z25	I16	.60	Tooth
75379	Z31	I15	.90	Tooth
75379	Z34	I15	.40	Tooth
75380	AA58	M4.5	.50	Tooth

TABL

OCCURRENCE OF FOSSILS AT OUTCROPS OF THE

TAXA \ LOCALITIES (G.S.C.)	85789	85790	85791	85792	85793	85794	85795	85796	85797
PLANTAE									
Moellerina greenei	1	-	-	-	2	-	-	-	-
Tasmanites sp.	C	C	C	C	C	C	C	C	C
PROTISTA									
Psammosphaera delicatula	1	1	-	-	-	-	-	-	-
P. devonica	-	-	-	-	-	-	-	-	-
P. discoidea	-	-	-	-	-	-	-	-	-
P. rotunda	-	-	-	-	-	-	-	-	-
Sorosphaera bicelloidea	-	-	1	-	-	-	-	-	-
S. columbiense	-	-	1	-	-	-	-	-	-
Webbinelloidea hemispherica	-	-	-	-	-	-	-	-	-
W. polygonia	-	-	-	-	-	-	-	-	-
W. similis	-	-	1	-	-	-	-	-	-
W. sola	-	-	3	-	-	-	-	-	-
PORIFERA									
Astraeospongium spp.	3	7	15	5	9	1	3	-	1
Clionolithes ? sp.	-	-	1	-	-	-	-	-	-
COELENTERATA ?									
Stromatoporella sp.	-	-	-	-	-	-	-	-	-
Syringostroma sp.	-	-	-	-	-	-	-	-	-
COELENTERATA									
Asthenophyllum ? sp.	2	-	-	-	-	-	2	-	-
Heterophrentis inflata	-	-	1	-	1	-	-	-	-
H. ? sp.	-	-	-	1	1	-	1	-	-
Heliophyllum halli	-	-	-	-	-	-	-	-	-
H. sp.	-	-	-	-	-	-	-	-	-
Acinophyllum cf. A. stramineum	-	-	-	-	-	-	-	-	-
A. sp.	-	-	-	-	-	-	-	-	-
Hexagonaria truncata	-	-	-	-	-	-	-	-	-

TABLE 2

LS AT OUTCROPS OF THE DELAWARE LIMESTONE IN ONTARIO AND ADJACENT

85792	85793	85794	85795	85796	85797	85798	85799	85800	85801	85802	85803	85804	85805	85806	85807	Delaware Fm. Ohio
-	2	-	-	-	-	-	-	-	4	4	-	-	-	-	-	X
C	C	C	C	C	C	C	C	C	C	C	R	-	-	R	C	X
-	-	-	-	-	-	-	-	-	3	4	-	-	-	1	-	-
-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	X
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	X
-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	X
-	-	-	-	-	-	1	-	-	1	4	-	-	-	-	-	X
-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	X
-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	X
-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	X
-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	X
-	-	-	-	-	-	-	1	-	5	5	-	-	-	-	-	X
5	9	1	3	-	1	-	-	3	7	15	-	-	-	3	-	X
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
-	-	-	2	-	-	-	-	-	-	1	-	-	-	-	-	-
-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
1	1	-	1	-	-	1	-	-	1	1	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
-	-	-	-	-	-	-	-	-	-	-	-	100+	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	20+	-	-
-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-

2

AWARE LIMESTONE IN ONTARIO AND ADJACENT REGIONS

85799	85800	85801	85802	85803	85804	85805	85806	85807	Delaware Fm. Ohio	Dundee Fm. Mich., Ont., Ohio	Columbus Fm. Ohio	Seneca Mbr. Central N.Y.	Moorehouse Mbr. Central N.Y.	Seneca Mbr. Eastern N.Y.	Moorehouse Mbr. Eastern N.Y.
-	-	4	4	-	-	-	-	-	X	X	X	-	-	-	-
C	C	C	C	R	-	-	R	C	X	X	X	-	-	-	-
-	-	3	4	-	-	-	1	-	-	-	X	-	-	-	-
-	-	-	2	-	-	-	1	-	X	-	X	-	-	-	-
-	-	-	1	-	-	-	-	-	X	-	X	-	-	-	-
-	-	-	2	-	-	-	-	-	X	-	X	-	-	-	-
-	-	1	4	-	-	-	-	-	X	-	X	-	-	-	-
-	-	-	2	-	-	-	1	-	X	-	X	-	-	-	-
-	-	1	2	-	-	-	-	-	X	-	X	-	-	-	-
1	-	-	1	-	-	-	-	-	X	-	X	-	-	-	-
-	-	1	-	-	-	-	-	-	X	-	X	-	-	-	-
1	-	5	5	-	-	-	-	-	X	-	X	-	-	-	-
-	3	7	15	-	-	-	3	-	X	X	X	-	X	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	2	-	-	-	-	-	-	-	?	-	-	-	-	-
-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
-	-	1	-	-	-	-	-	-	-	?	-	?	-	-	-
-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
-	-	1	1	-	-	-	1	-	-	X	-	-	-	X	-
-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
-	-	-	-	-	100+	-	-	-	-	X	?	-	?	-	-
-	-	-	-	-	-	-	20+	-	-	-	-	-	-	-	-
-	-	1	-	-	-	-	-	-	-	X	-	X	-	-	-
-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-

Heliophyllum halli	-	-	-	-	-	-	-	-	-
H. sp.	-	-	-	-	-	-	-	-	-
Acinophyllum cf. A. stramineum	-	-	-	-	-	-	-	-	-
A. sp.	-	-	-	-	-	-	-	-	-
Hexagonaria truncata	-	-	-	-	-	-	-	-	-
Cystiphylloides cf. C. americanum	-	-	-	-	-	10	-	-	-
Edaphophyllum cf. E. bifurcatum	-	-	-	-	5	-	-	-	-
Chaetetes sp.	-	-	-	-	-	-	-	-	-
Favosites sp.	1	-	-	-	-	-	-	-	-
Cladopora sp.	-	-	-	-	-	-	-	-	-
BRYOZOA									
Fistulipora cf. F. ponderosa	-	-	-	-	-	-	-	-	-
Fenestella cf. F. sylvia	-	-	-	-	-	-	-	-	-
Polypora cf. Fenestella (P.) robusta	-	-	-	-	-	-	-	-	-
Orthopora cf. O. bispinulata	-	-	-	-	-	-	-	-	-
Sulcoretepora gilberti	2	3	-	-	-	-	-	-	-
BRACHIOPODA									
Lingula sp.	-	-	-	-	-	-	1	-	-
Craniops hamiltonice	-	-	-	1	-	-	-	-	-
Schizophoria multistriata	-	-	-	-	1	1	1	-	-
Rhipidomella cf. R. cyclas	-	-	-	-	5	-	-	-	-
Leptaena rhomboidalis	2	-	-	-	1	-	2	-	1
Strophodonta demissa	-	-	-	-	-	-	-	-	-
Megastrophia concava	1	-	-	-	-	1	1	-	-
Protoleptostrophia perplana	-	-	-	1	-	-	-	-	1
Longispina deflectus	-	-	-	-	-	-	-	-	-
"Chonetes" sp.	2	1	1	-	1	-	-	-	-
Pentamerella arata	-	-	-	-	-	-	1	-	-
Camarotoechia sappho	-	-	-	-	-	-	2	-	-
Atrypa reticularis	5	2	-	-	2	1	1	-	1
Spinatrypa spinosa	8	3	4	-	5	3	3	-	2
Nucleospira concinna	4	5	5	2	2	3	5	-	2
Cyrtina hamiltonensis	4	5	5	4	3	-	2	-	3
C. umbonata var. alpeaensis	2	-	-	-	1	-	-	-	1
Delthyris raricosta	-	-	-	-	-	-	-	-	-
Brevispirifer lucasensis	5	2	3	6	10	3	7	-	2
"Spirifer" macrus	-	-	-	-	-	-	-	-	-
Spinulicosta spinulicosta	-	-	-	-	-	-	-	-	-
Martiniopsis? maia	-	-	-	-	-	-	-	-	-
"Spirifer" cf. "S." duodenarius	-	-	-	-	-	-	-	-	-
"S." sp. A	-	-	-	-	-	-	-	-	-

-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
-	-	-	-	-	-	-	-	-	-	-	-	-	100+	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20+	-
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	5	-	-	-	-	-	-	-	5	5	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	5	-	2	-	-	3	-
-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2	-
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	4	10	5	-	3	-	-	5
-	-	-	-	-	-	-	-	-	1	2	2	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	2	4	4	-	-	-	-	3
-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-
-	1	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-
-	-	1	1	1	-	-	-	-	-	1	-	1	1	-	-	-
-	-	5	-	-	-	-	-	-	-	-	2	-	-	-	-	-
-	-	1	-	2	-	1	3	-	-	14	2	-	2	-	-	-
-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-
-	-	-	1	1	-	-	1	-	-	1	-	1	1	-	-	-
-	1	-	-	-	-	1	1	-	-	1	1	-	1	-	-	-
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1	-	1	-	-	-	-	-	8	-	2	2	-	-	-	-	-
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4	-	5	3	3	-	2	-	-	2	15	12	1	1	-	1	5
5	2	2	3	5	-	2	-	-	-	1	-	-	-	-	-	-
5	4	3	-	2	-	3	-	-	-	-	-	-	-	-	-	-
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3	6	10	3	7	-	2	3	-	-	45	18	2	2	-	2	4
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4	10	5	-	3	-	-	5	-	-	-	-	-	-	-
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2	4	4	-	-	-	-	3	-	X	-	-	-	-	-
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Spirifer macrus	-	-	-	-	-	-	-	-	-
Spinulicosta spinulicosta	-	-	-	-	-	-	-	-	-
Martiniopsis? mala	-	-	-	-	-	-	-	-	-
"Spirifer" cf. "S." duodenarius	-	-	-	-	-	-	-	-	-
"S." sp. A	-	-	-	-	-	-	-	-	-
PELECYPODA									
Solemya (Janeia) vetusta	-	-	-	-	-	-	-	-	-
Paracyclas cf. P. elliptica	-	-	-	-	-	-	1	-	-
Cypricardina cf. C. consimilis	-	-	-	-	-	-	1	-	-
Conocardium cuneus?	-	-	-	-	-	-	-	-	-
GASTROPODA									
Pleuronotus? sp. A	-	-	-	-	-	2	1	-	-
P.? sp. B	-	-	-	-	-	-	-	-	-
Platyceras (Platyceras) erectum	-	-	-	-	-	-	-	-	-
CEPHALOPODA									
Michelinoceras sp.	-	-	-	-	-	-	-	-	-
CRICOCONARIDA									
Tentaculites sclariformis	-	-	-	-	2	-	-	-	-
T. gracilistriatus	-	-	-	-	1	-	-	-	-
ANNELIDA									
Drilonereisites apdus	-	-	-	-	-	-	-	-	-
D. longicusculus	2	-	-	-	-	-	-	-	2
Siluropelta annae	1	-	-	-	-	-	-	-	-
Leodicites spp.	1	2	7	2	-	-	-	-	1
Ildraites spp.	-	1	1	1	1	-	-	-	1
Paleoenoites spp.	-	-	-	-	-	-	-	-	-
Lumbriconereites spp.	1	-	2	1	-	-	-	-	-
Staurocephalites spp.	1	1	-	1	-	-	-	-	1
Arabellites spp.	-	1	3	-	-	-	-	-	-
Nereidavus spp.	-	-	5	-	-	-	-	-	1
Anisocerasites spp.	-	-	-	-	-	-	-	-	-
ARTHROPODA									
Dechenella (Bassidechenella) rowi	-	-	-	-	-	-	-	-	-
Proetus (Crassiproetus) crassimarginatus	2	-	-	-	-	-	1	-	-
ECHINODERMATA									
Arachnocrinus bulbosus	-	-	-	-	-	-	-	-	-
A. ignotus?	-	-	-	-	-	-	-	-	-
Protocaudina kansasensis	2	6	2	-	4	2	3	-	-

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1	-	-	-	1	-	-	1	4	4	-	-	-	-	-	X	X
-	-	-	-	-	-	-	-	14	6	-	-	-	1	-	X	X
-	-	-	-	-	-	-	-	11	14	-	-	-	2	-	X	X
-	-	-	-	1	-	-	1	9	13	-	-	-	1	-	X	X
-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	X	X
-	-	-	-	1	-	2	-	10	10	-	-	1	-	-	X	X
-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	X	X
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4	2	3	-	-	-	-	3	11	16	-	-	-	-	-	-	-

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1	25	12	-	-	-	5	-	X	X	-	-	-	-	-
1	4	4	-	-	-	-	-	X	X	-	-	-	-	-
-	14	6	-	-	-	1	-	X	X	-	-	-	-	-
-	11	14	-	-	-	2	-	X	X	-	-	-	-	-
1	9	13	-	-	-	1	-	X	X	-	-	-	-	-
-	8	-	-	-	-	-	-	X	X	-	-	-	-	-
-	10	10	-	-	1	-	-	X	X	-	-	-	-	-
-	6	-	-	-	-	-	-	X	X	-	-	-	-	-
2	4	2	-	-	-	-	-	X	X	X	-	-	-	-
-	5	-	-	-	-	-	-	-	X	X	-	-	-	-
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Anisocerasites spp.	-	-	-	-	-	-	-	-	-
ARTHROPODA									
Dechenella (Bassidechenella) rowi	-	-	-	-	-	-	-	-	-
Proetus (Crassiproetus) crassimarginatus	2	-	-	-	-	-	1	-	-
ECHINODERMATA									
Arachnocrinus bulbosus	-	-	-	-	-	-	-	-	-
A. ignotus?	-	-	-	-	-	-	-	-	-
Protocaudina kansasensis	2	8	2	-	4	2	3	-	-
UNKNOWN									
Coleolus? sp.	-	-	-	-	-	-	-	-	-
CONODONTOPHORIDA									
Drepanodus sp.	-	-	-	-	1	-	-	-	-
Paltodus cf. P. belatus	-	-	-	-	-	-	-	-	-
Prioniodina? sp.	-	-	-	-	-	-	-	-	-
Angulodus cf. A. walrathi	-	1	-	1	-	-	1	-	1
A.? sp.	-	-	1	-	-	1	-	-	-
Ozarkodina cf. O. congesta	-	-	-	-	-	-	-	-	-
Plectospathodus? sp.	-	-	-	-	-	-	-	-	1
Bryantodus cf. B. planus	-	-	-	-	-	-	-	-	-
Hindeodella austinensis	-	6	4	-	1	2	-	-	-
H. lambtonensis	7	15	14	-	3	-	-	-	1
Ligonodina? sp.	-	7	10	4	-	-	-	-	-
Neoprioniodus cf. N. idoneus	1	-	3	-	-	1	-	-	-
N. n. sp. A	-	-	-	-	-	-	-	-	-
Hibbardella? sp.	-	-	-	-	-	1	-	-	-
Lochodina? sp.	-	-	-	-	-	-	-	-	-
Polygnathus linguiformis	6	13	23	2	8	-	6	-	2
P. sp.	-	1	1	-	2	-	-	-	1
Icriodus cf. I. expansus	-	-	-	2	-	-	-	-	1
I. nodosus	-	3	4	-	1	-	-	-	1
I. cymbiformis	-	-	-	1	-	-	-	-	-
I. angustus	-	-	-	-	-	-	-	-	-
I. latericrescens n. subsp. A	-	-	-	-	-	-	-	-	-
Lonchodus cf. L. dentatus	-	-	-	-	-	-	-	-	-
PISCES									
Ohioaspis impositus	-	-	-	-	1	-	-	-	-
O. lamellatus	-	-	-	-	-	-	-	-	-
O. tumulosus	-	-	-	-	1	-	-	-	-
Cladolepis gunnelli	-	-	-	-	1	-	-	-	-
Ohiolepis newberryi									

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2	-	4	2	3	-	-	-	-	3	11	16	-	-	-	-	-
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14	-	3	-	-	-	1	7	-	-	17	37	2	-	-	-	-
10	4	-	-	-	-	-	5	-	-	10	12	-	-	-	-	-
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23	2	8	-	6	-	2	7	-	1	27	46	2	-	-	-	-
1	-	2	-	-	-	1	1	-	-	1	8	-	-	-	-	-
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4	-	1	-	-	-	1	1	-	-	15	18	-	-	-	1	-
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3	11	16	-	-	-	-	-	-	-	-	-	-	-	-
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1	27	46	2	-	-	-	-	X	X	X	X	X	-	X
-	1	8	-	-	-	-	-	-	-	-	X	X	-	X
-	22	14	-	-	-	-	-	X	-	X	-	-	-	-
-	15	18	-	-	-	1	-	X	-	X	X	X	-	X
-	16	10	-	-	-	-	-	-	-	-	-	-	-	-
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-	3	15	-	-	-	-	-	?	-	?	-	-	-	-
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-	1	1	-	-	-	-	-	X	-	X	-	-	-	-

Bryantodus cf. B. planus	-	-	-	-	-	-	-	-	-
Hindeodella austinensis	-	6	4	-	1	2	-	-	-
H. lambtonensis	7	15	14	-	3	-	-	-	1
Ligonodina? sp.	-	7	10	4	-	-	-	-	-
Neoprioniodus cf. N. idoneus	1	-	3	-	-	1	-	-	-
N. n. sp. A	-	-	-	-	-	-	-	-	-
Hibardella? sp.	-	-	-	-	-	1	-	-	-
Lochodina? sp.	-	-	-	-	-	-	-	-	-
Polygnathus linguiformis	6	13	23	2	8	-	6	-	2
P. sp.	-	1	1	-	2	-	-	-	1
Icriodus cf. I. expansus	-	-	-	2	-	-	-	-	1
I. nodosus	-	3	4	-	1	-	-	-	1
I. cymbiformis	-	-	-	1	-	-	-	-	-
I. angustus	-	-	-	-	-	-	-	-	-
I. latericrescens n. subsp. A	-	-	-	-	-	-	-	-	-
Lonchodus cf. L. dentatus	-	-	-	-	-	-	-	-	-
PISCES									
Ohioaspis impositus	-	-	-	-	1	-	-	-	-
O. lamellatus	-	-	-	-	-	-	-	-	-
O. tumulosus	-	-	-	-	1	-	-	-	-
Cladolepis gunnelli	-	-	-	-	1	-	-	-	-
Ohiolepis newberryi	-	-	-	-	-	-	-	-	-
O. stewartae	-	-	-	-	-	-	-	-	-
Phoebodus? bryanti	-	-	-	-	-	-	-	-	-
P. floweri	-	-	-	-	-	-	-	-	-
Plectrodus aculeatus	-	-	-	-	-	-	-	-	-
P. multidentatus	-	-	-	-	-	-	-	-	-
P. ohioensis	-	-	-	-	-	-	-	-	-
Acanthoides dublinensis	-	-	-	-	-	-	-	-	-
A. hardyi	-	-	-	-	-	-	-	-	1
A. sciotoensis	-	-	1	-	1	-	-	-	-
Cheiracanthoides comis	-	-	-	-	-	-	-	-	-
C. comptus	1	-	3	-	2	-	2	-	5
C. venustus	-	-	-	-	-	-	-	-	-
Helolepis bellarugosus	-	-	-	-	-	-	-	-	-
Onychodus sigmoides	-	1	4	-	4	2	-	-	1

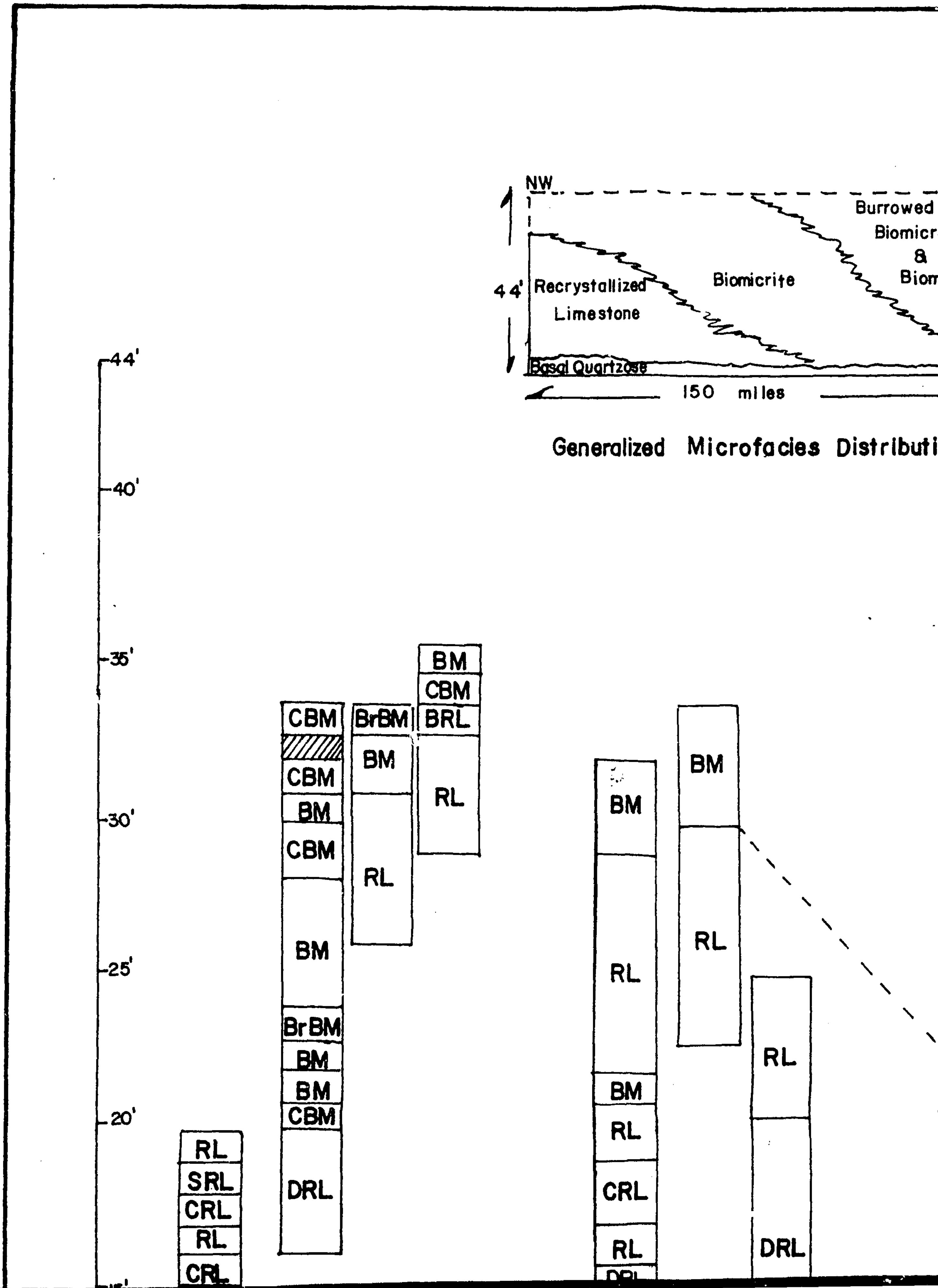
C = Common R = Rare X = Present

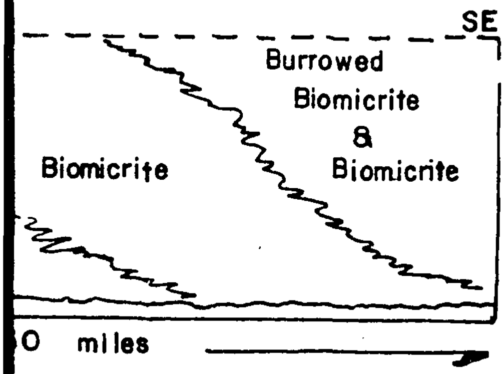
-	-	-	-	-	-	-	1	12	-	-	-	-	-	-	-	?
2	-	-	-	4	-	-	15	28	-	-	-	-	-	-	-	-
-	-	-	1	7	-	-	17	37	2	-	-	-	-	-	-	-
-	-	-	-	5	-	-	10	12	-	-	-	-	-	-	-	?
1	-	-	-	3	-	-	5	9	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	3	1	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	2	5	4	-	-	-	-	-	-	-	-
-	6	-	2	7	-	1	27	46	2	-	-	-	-	X	X	X
-	-	-	1	1	-	-	1	8	-	-	-	-	-	-	-	-
-	-	-	1	5	-	-	22	14	-	-	-	-	-	X	-	X
-	-	-	1	1	-	-	15	18	-	-	-	1	-	X	-	X
-	-	-	-	2	-	-	16	10	-	-	-	-	-	-	-	-
-	-	-	-	1	-	-	4	-	-	-	-	-	-	X	X	X
-	-	-	-	-	-	-	?	-	-	-	-	7	-	X	-	X
-	-	-	-	-	-	-	3	15	-	-	-	-	-	?	-	?
-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X
-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	X
-	-	-	-	-	-	-	5	2	-	-	-	2	-	X	-	X
-	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	X
-	-	-	-	-	-	-	1	1	-	-	-	-	-	X	-	X
-	-	-	-	-	-	-	9	3	-	-	1	-	-	X	-	X
-	-	-	-	-	-	-	-	1	-	-	-	-	-	X	-	X
-	-	-	-	-	-	-	1	1	-	-	-	-	-	X	-	X
-	-	-	-	-	-	-	-	2	1	-	-	-	-	X	-	X
-	-	-	-	-	-	-	2	-	-	-	-	-	-	X	-	X
-	-	-	-	-	1	-	-	-	-	-	-	1	-	X	-	X
-	-	-	-	-	-	-	34	22	-	-	1	-	-	X	-	X
-	-	-	1	-	-	-	1	-	-	-	-	-	-	X	-	X
-	-	-	-	1	-	-	4	1	-	-	-	-	-	X	-	X
-	-	-	-	-	1	-	7	3	-	-	-	-	-	X	-	X
-	2	-	5	4	-	1	77	42	-	-	1	-	-	X	-	X
-	-	-	-	-	-	-	-	1	-	-	-	-	-	X	-	X
-	-	-	-	-	-	-	-	3	-	-	-	-	-	X	-	X
2	-	-	1	-	-	-	39	42	1	-	4	1	-	X	-	X
													TOTAL =	67	53	6[illegible]

re X = Present - = Absent ? = Possibly Present

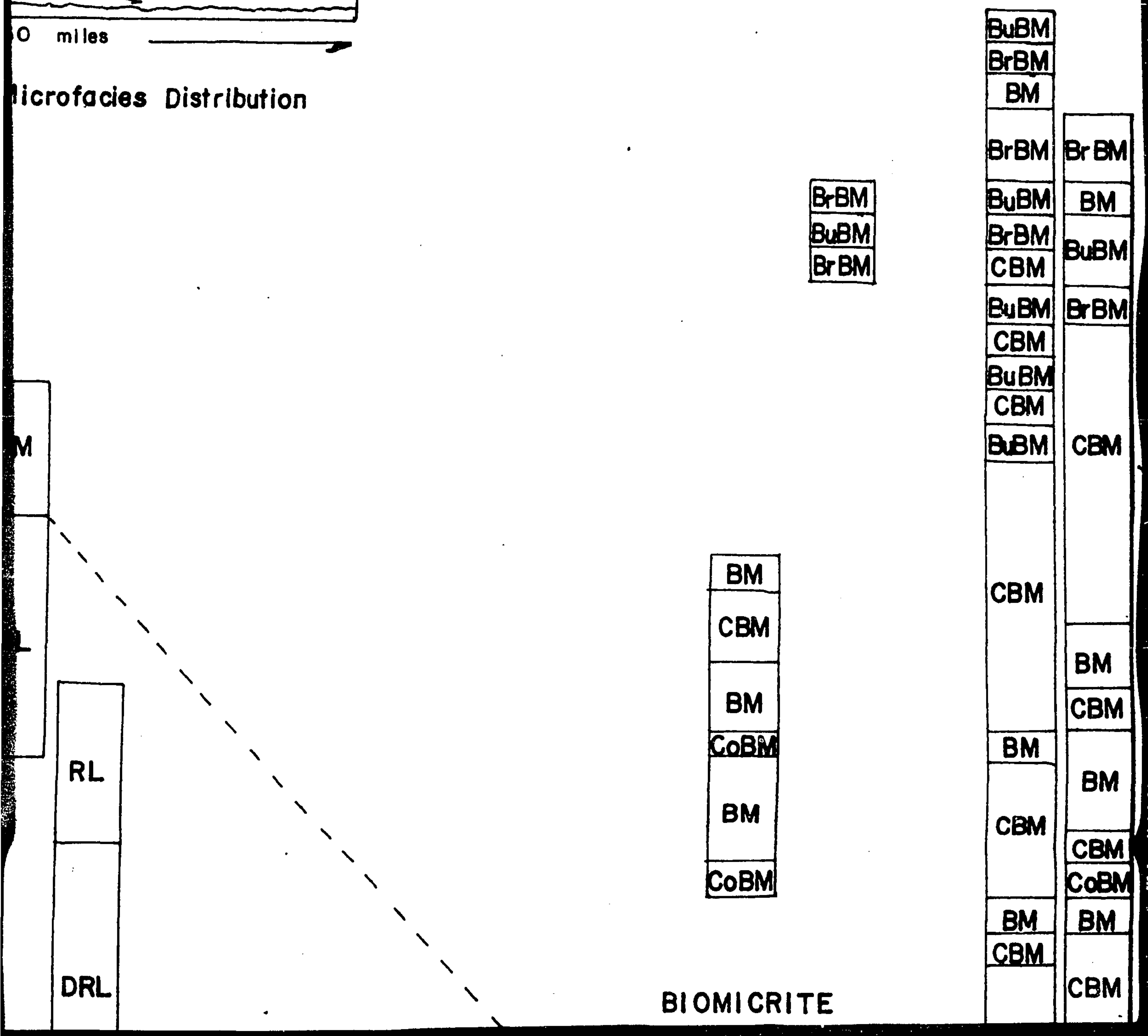
-	1	12	-	-	-	-	-	-	-	?	-	-	-	-
-	15	28	-	-	-	-	-	-	-	-	-	-	-	-
-	17	37	2	-	-	-	-	-	-	-	-	-	-	-
-	10	12	-	-	-	-	-	-	-	?	-	-	-	-
-	5	9	-	-	-	-	-	-	-	-	-	-	-	-
-	3	1	-	-	-	-	-	-	-	-	-	-	-	-
-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
2	5	4	-	-	-	-	-	-	-	-	-	-	-	-
1	27	46	2	-	-	-	-	X	X	X	X	X	-	X
-	1	8	-	-	-	-	-	-	-	-	X	X	-	X
-	22	14	-	-	-	-	-	X	-	X	-	-	-	-
-	15	18	-	-	-	1	-	X	-	X	X	X	-	X
-	16	10	-	-	-	-	-	-	-	-	-	-	-	-
-	4	-	-	-	-	-	-	X	X	X	-	-	-	-
-	?	-	-	-	-	7	-	X	-	X	X	X	-	X
-	3	15	-	-	-	-	-	?	-	?	-	-	-	-
-	-	-	-	-	-	-	-	X	-	X	-	-	-	-
-	2	1	-	-	-	-	-	-	-	X	-	-	-	-
-	5	2	-	-	-	2	-	X	-	X	-	-	-	-
-	-	-	-	-	-	-	-	X	-	X	-	-	-	-
-	1	1	-	-	-	-	-	X	-	X	-	-	-	-
-	9	3	-	-	1	-	-	X	-	X	-	-	-	-
-	-	1	-	-	-	-	-	X	-	X	-	-	-	-
-	1	1	-	-	-	-	-	X	-	X	-	-	-	-
-	-	2	1	-	-	-	-	X	-	X	-	-	-	-
-	2	-	-	-	-	-	-	X	-	X	-	-	-	-
-	-	-	-	-	-	1	-	X	-	X	-	-	-	-
-	34	22	-	-	1	-	-	X	-	X	-	-	-	-
-	1	-	-	-	-	-	-	X	-	X	-	-	-	-
-	4	1	-	-	-	-	-	X	-	X	-	-	-	-
-	7	3	-	-	-	-	-	X	-	X	-	-	-	-
1	77	42	-	-	1	-	-	X	-	X	-	-	-	-
-	-	1	-	-	-	-	-	X	-	X	-	-	-	-
-	-	3	-	-	-	-	-	X	-	X	-	-	-	-
-	39	42	1	-	4	1	-	X	-	X	X	-	-	-
							TOTAL =	67	53	65	18	21	10	17

Absent ? = Possibly Present


NW
Burrowed
Biomicri
&
Biom
Biomicrite
44'
Recrystallized
Limestone
Basal Quartzose
150 miles
Generalized Microfacies Distributi
44'
40'
35'
30'
25'
20'
RL
SRL
CRL
RL
CRL
CBM
CBM
BM
CBM
BM
BrBM
BM
BM
CBM
DRL
BrBM
BM
RL
BM
CBM
BRL
RL
BM
RL
BM
RL
CRL
RL
BM
RL
RL
DRL



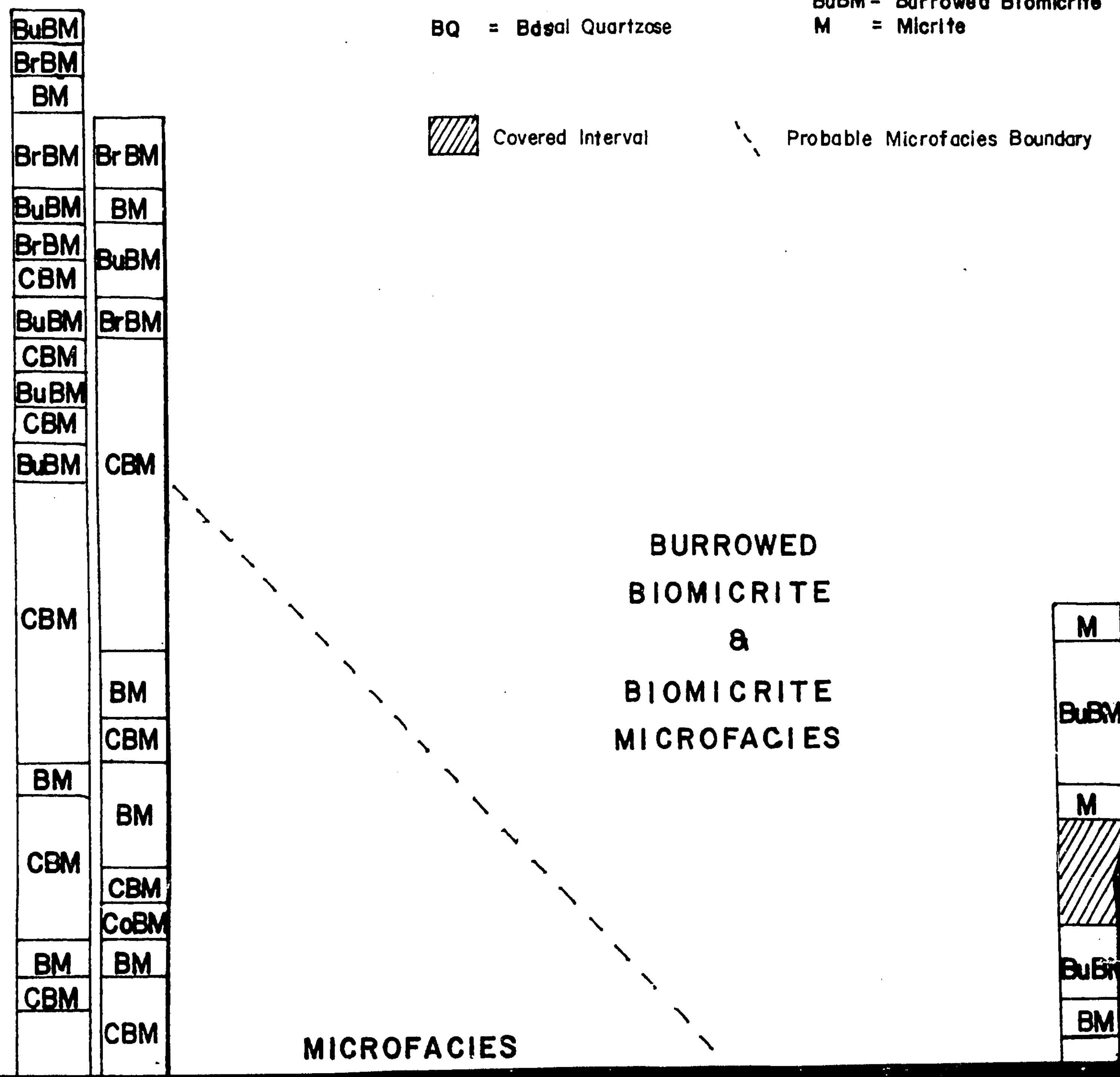
licrofacies Distribution



KEY TO MICROFACIES

RL	= Recrystallized Limestone	BM	= Biomicrite
CRL	= Crinoid Recrystallized Ls.	CoBM	= Coral Biomicrite
SRL	= Spore Recrystallized Ls.	CBM	= Crinoid Biomicrite
DRL	= Dolomitic Recrystallized Ls.		
CHE	= Chert	BrBM	= Brachiopod Biomicrite
		BuBM	= Burrowed Biomicrite
BQ	= Basal Quartzose	M	= Micrite

Covered Interval — Probable Microfacies Boundary



MICROFACIES

KEY TO MICROFACIES

RL = Recrystallized Limestone
CRL = Crinoid Recrystallized Ls.
SRL = Spore Recrystallized Ls.
DRL = Dolomitic Recrystallized Ls.

CHE = Chert

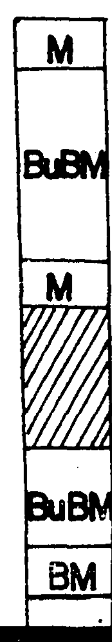
BQ = Basal Quartzose

BM = Biomicrite
CoBM = Coral Biomicrite
CBM = Crinoid Biomicrite

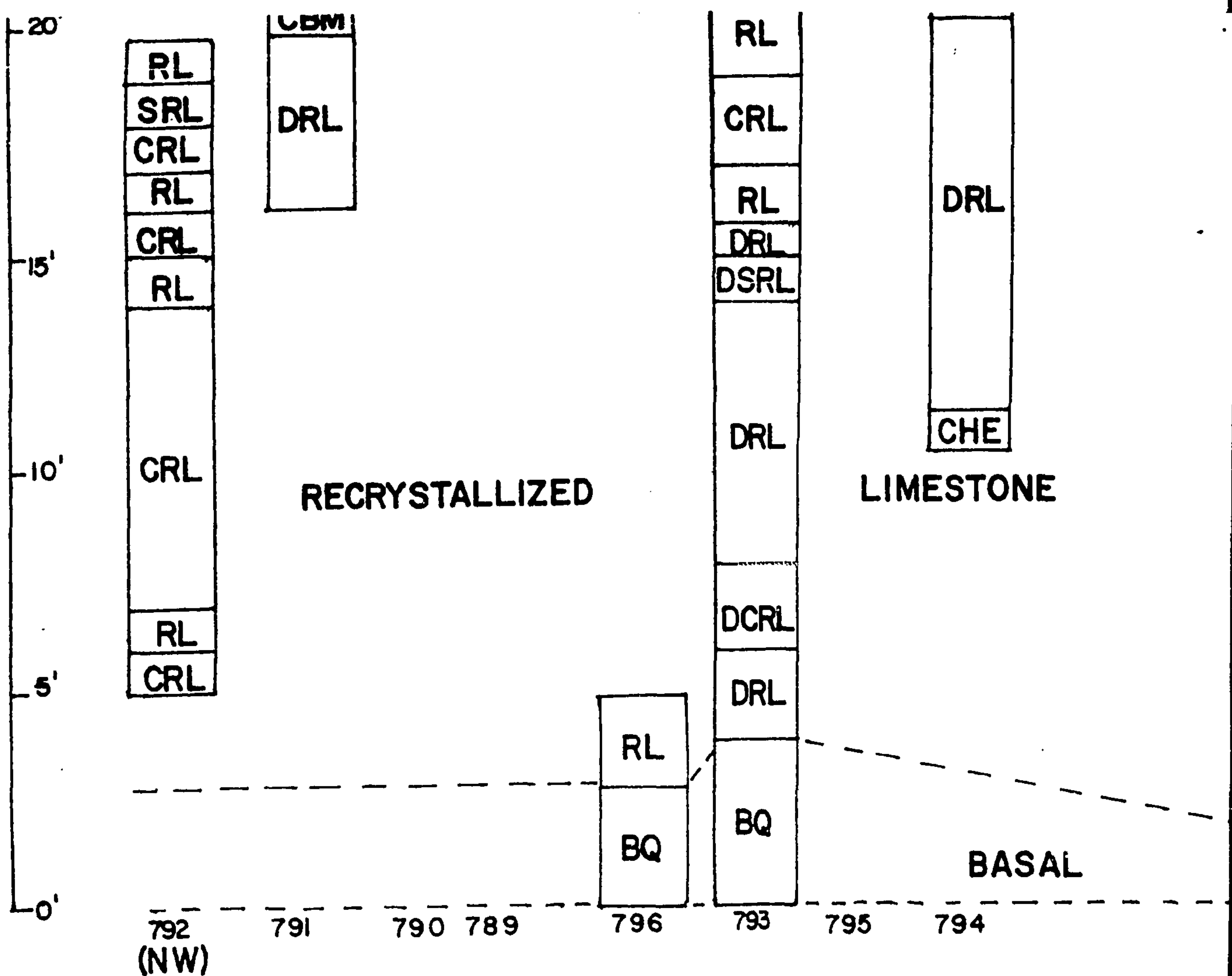
BrBM = Brachiopod Biomicrite
BuBM = Burrowed Biomicrite
M = Micrite

Covered Interval — Probable Microfacies Boundary

BURROWED
BIOMICRITE
&
BIOMICRITE
MICROFACIES

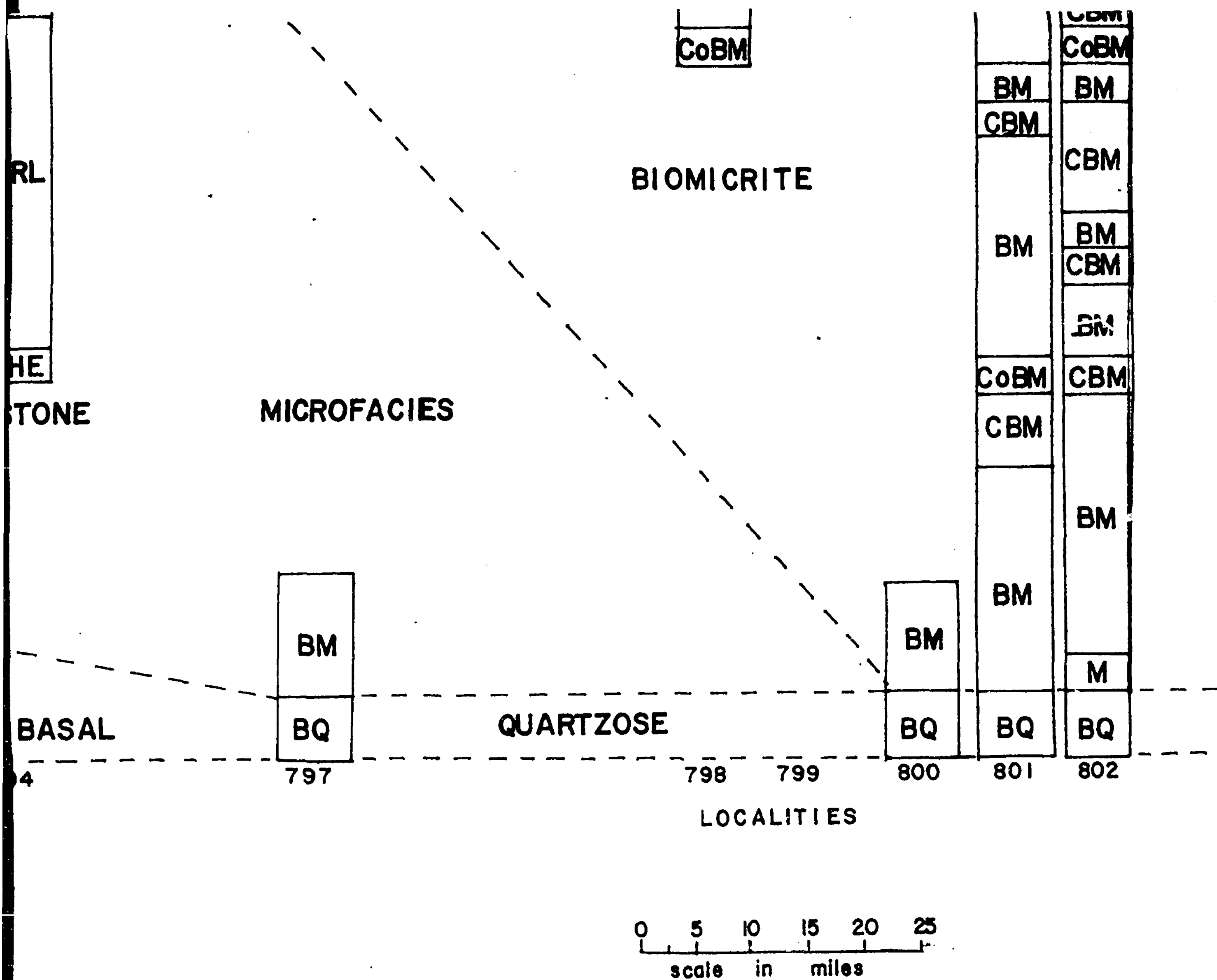


CROFACIES



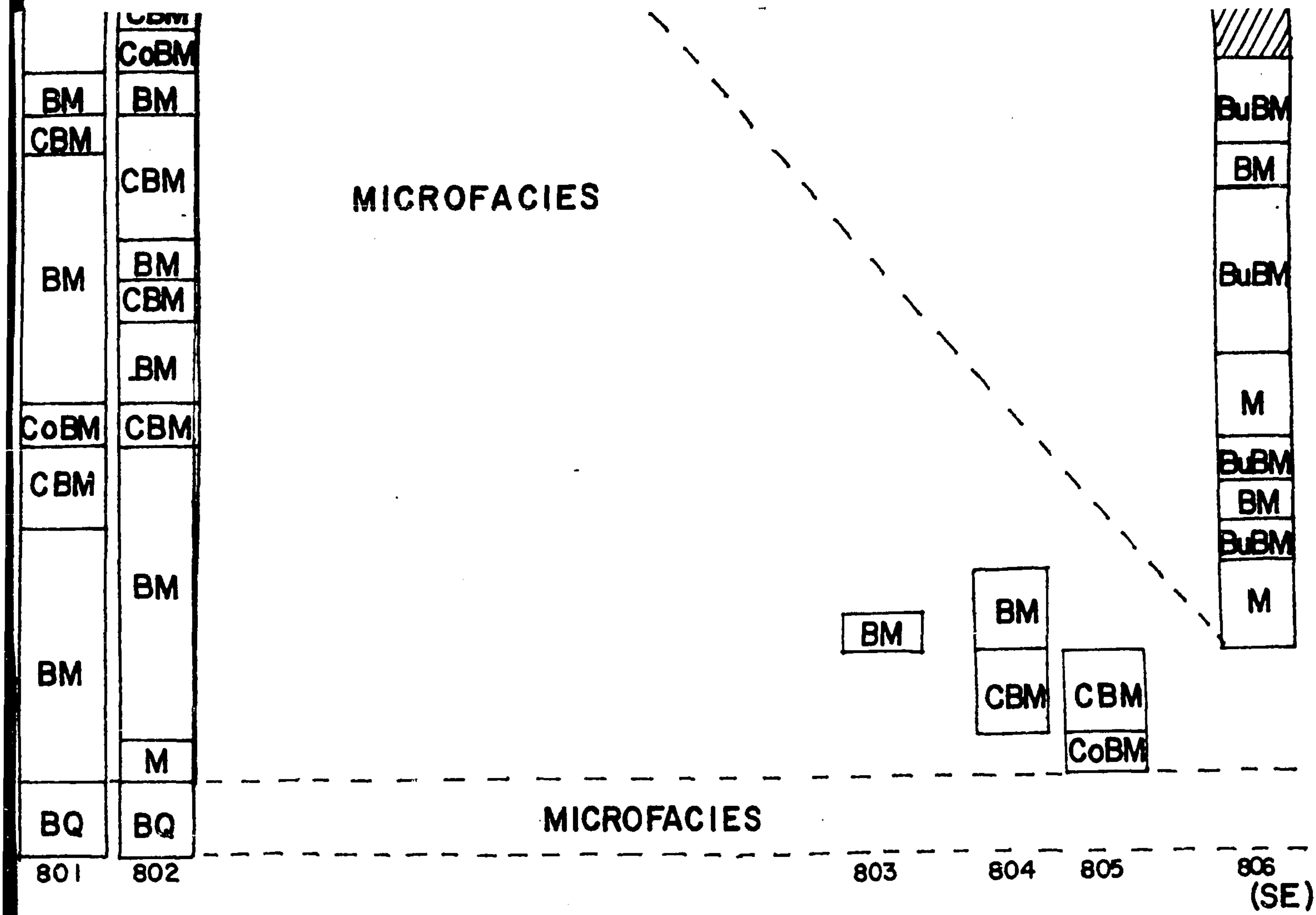
20'
15'
10'
5'
0'
RL
SRL
CRL
RL
CRL
RL
CRL
RL
CRL
CBM
DRL
RL
CRL
RL
DRL
DSRL
DRL
DCRL
DRL
BQ
RL
BQ
DRL
CHE
RECRYSTALLIZED
LIMESTONE
BASAL
792
(NW)
791
790
789
796
793
795
794

MICR

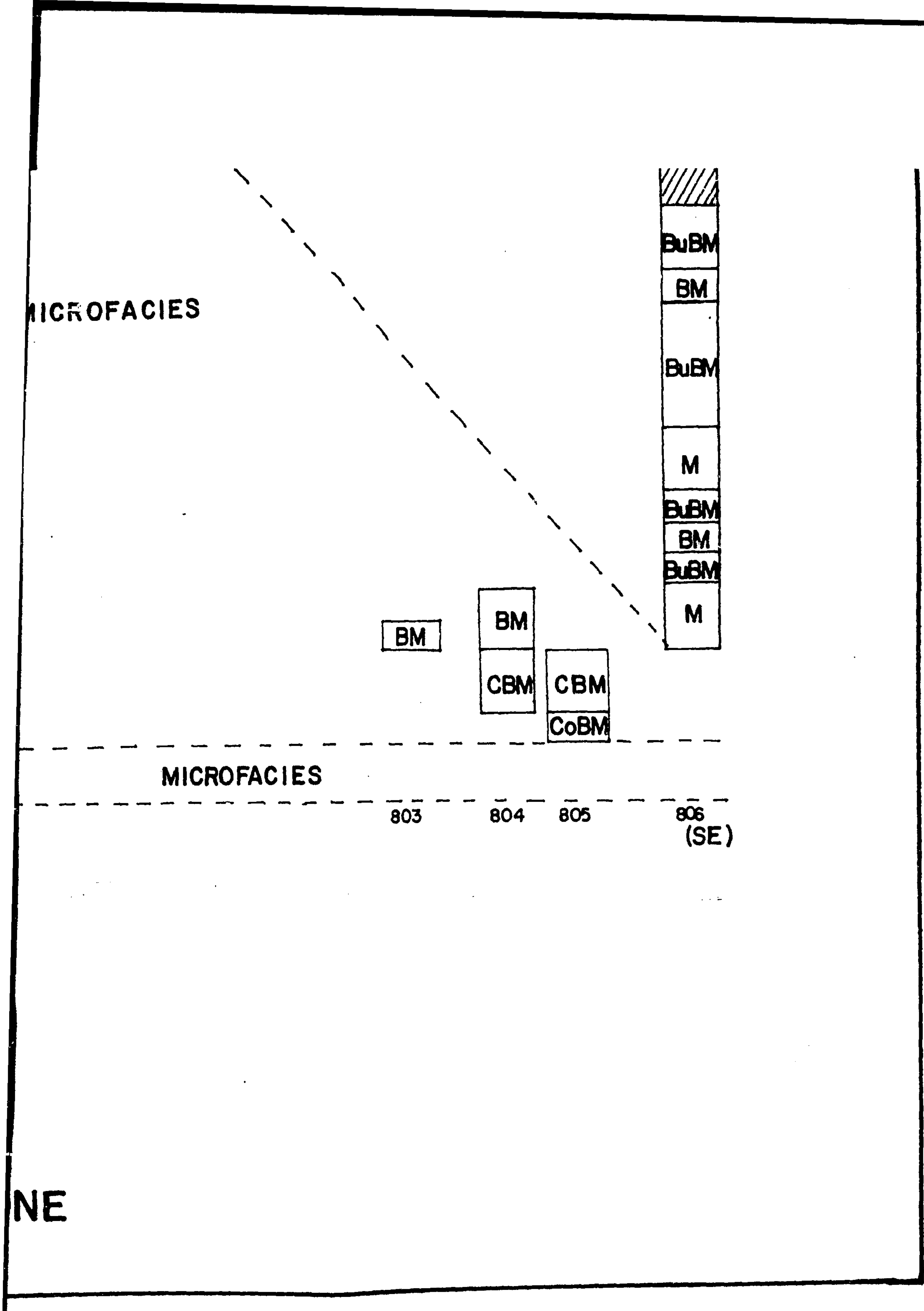


TEXT - FIGURE 6

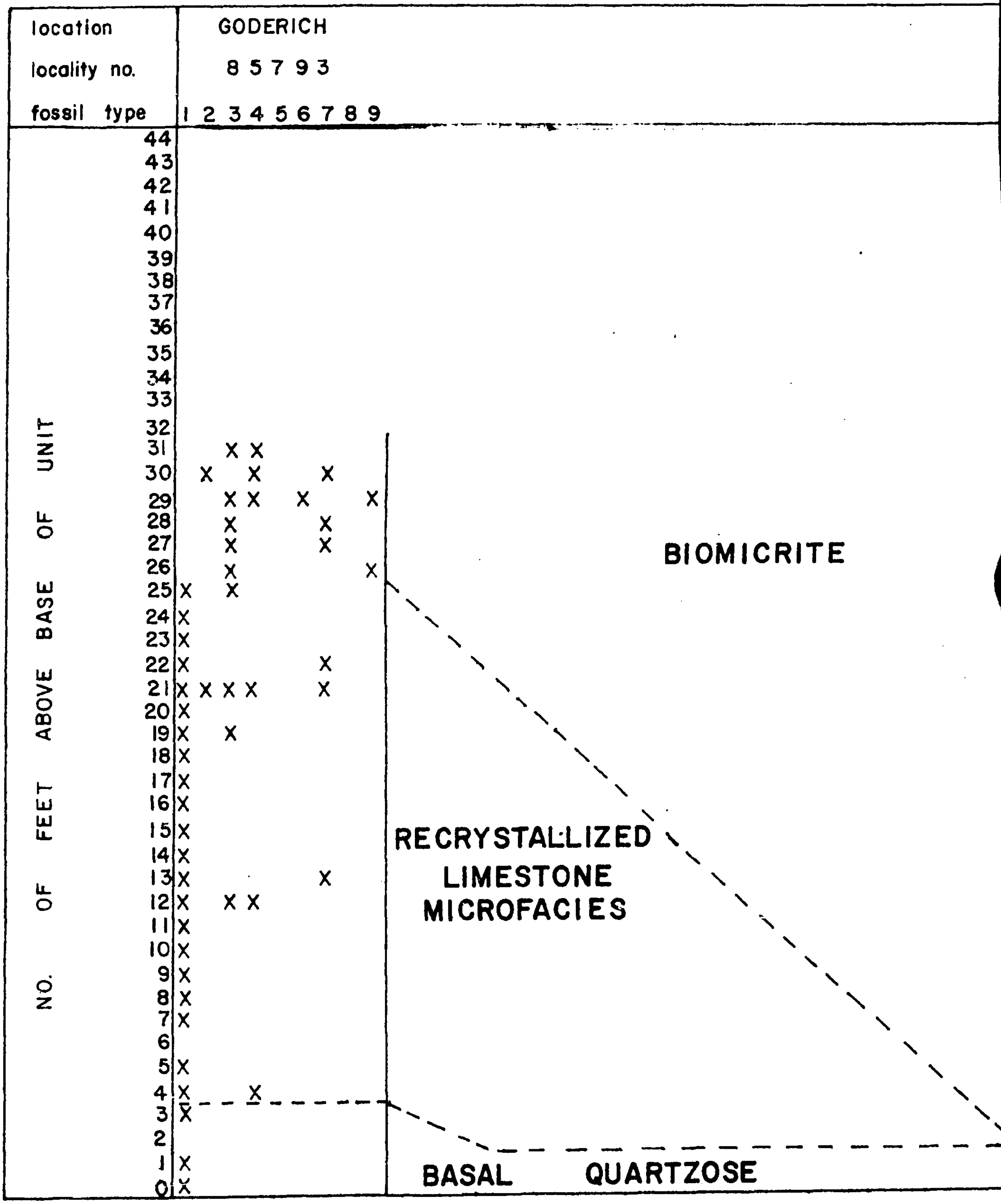
MICROFACIES OF THE DELAWARE LIMEST



RE LIMESTONE

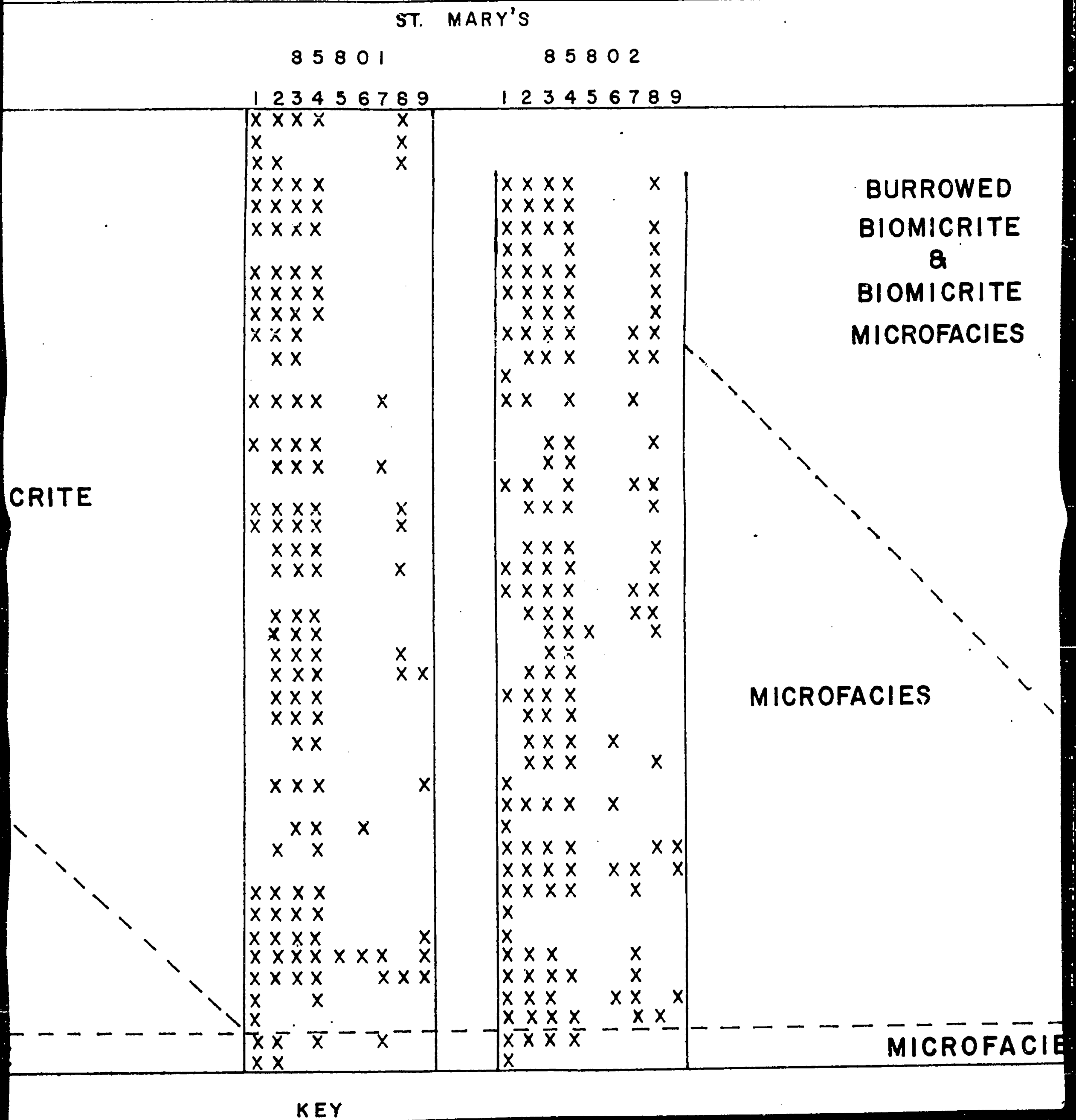

ICROFACIES
BuBM
BM
BuBM
M
BuBM
BM
BuBM
M
BM
BM
CBM
CBM
CoBM
MICROFACIES
803
804
805
806
(SE)
NE

COMPARISO
MICROFO

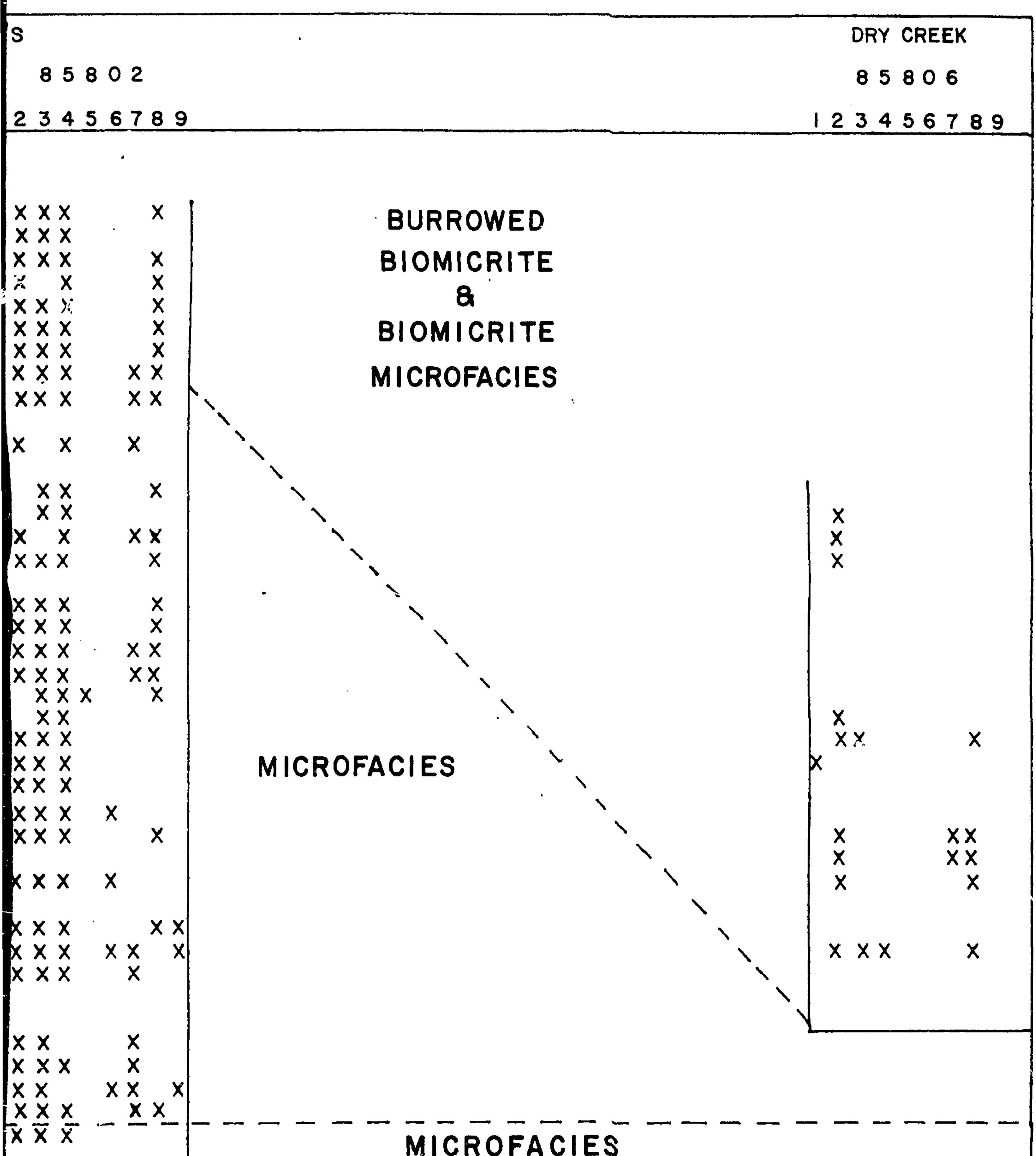


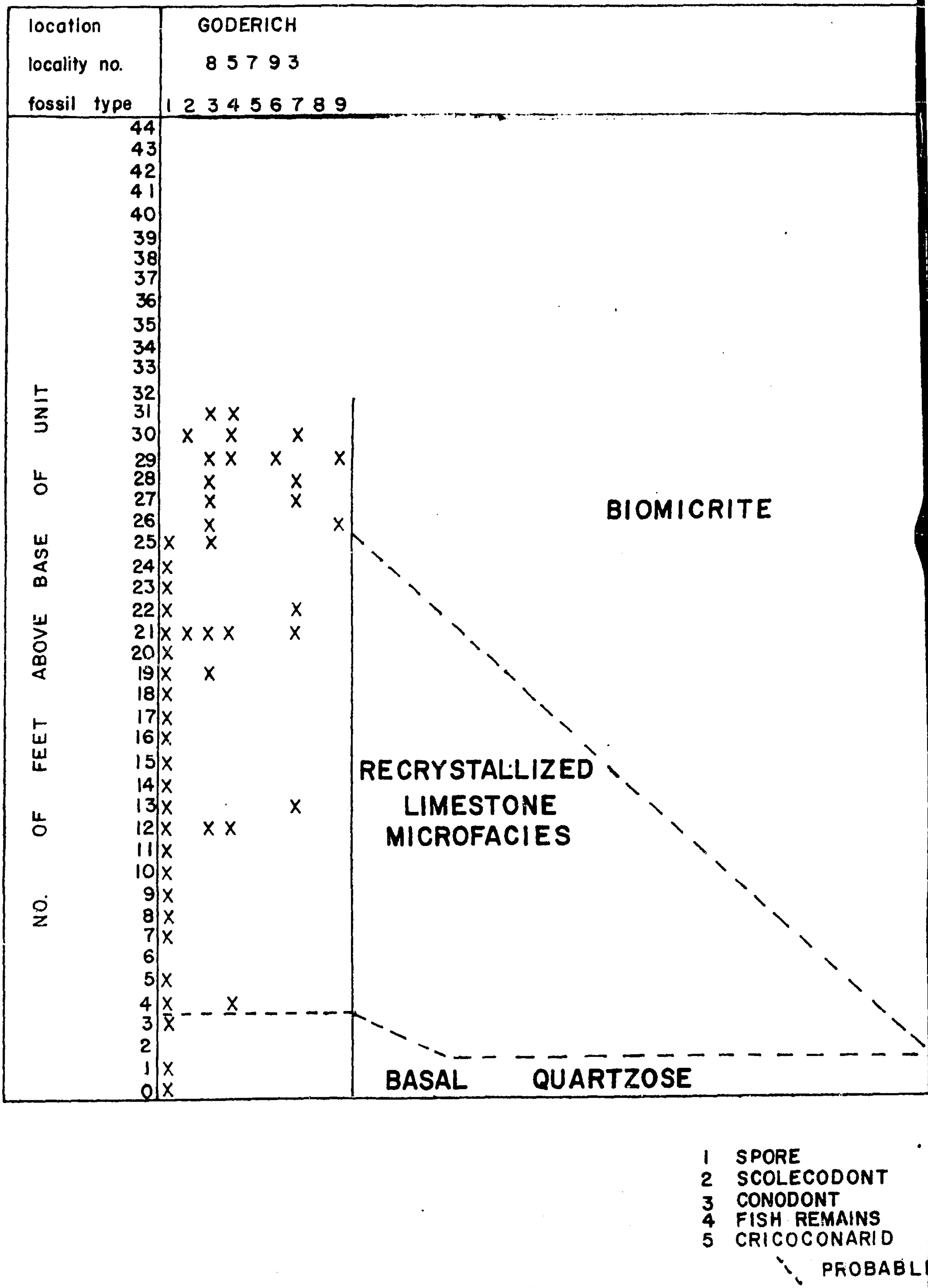
COMPARISON OF MICROFACIES TO MICROFOSSIL DISTRIBUTION

TEXT - FIGURE 15

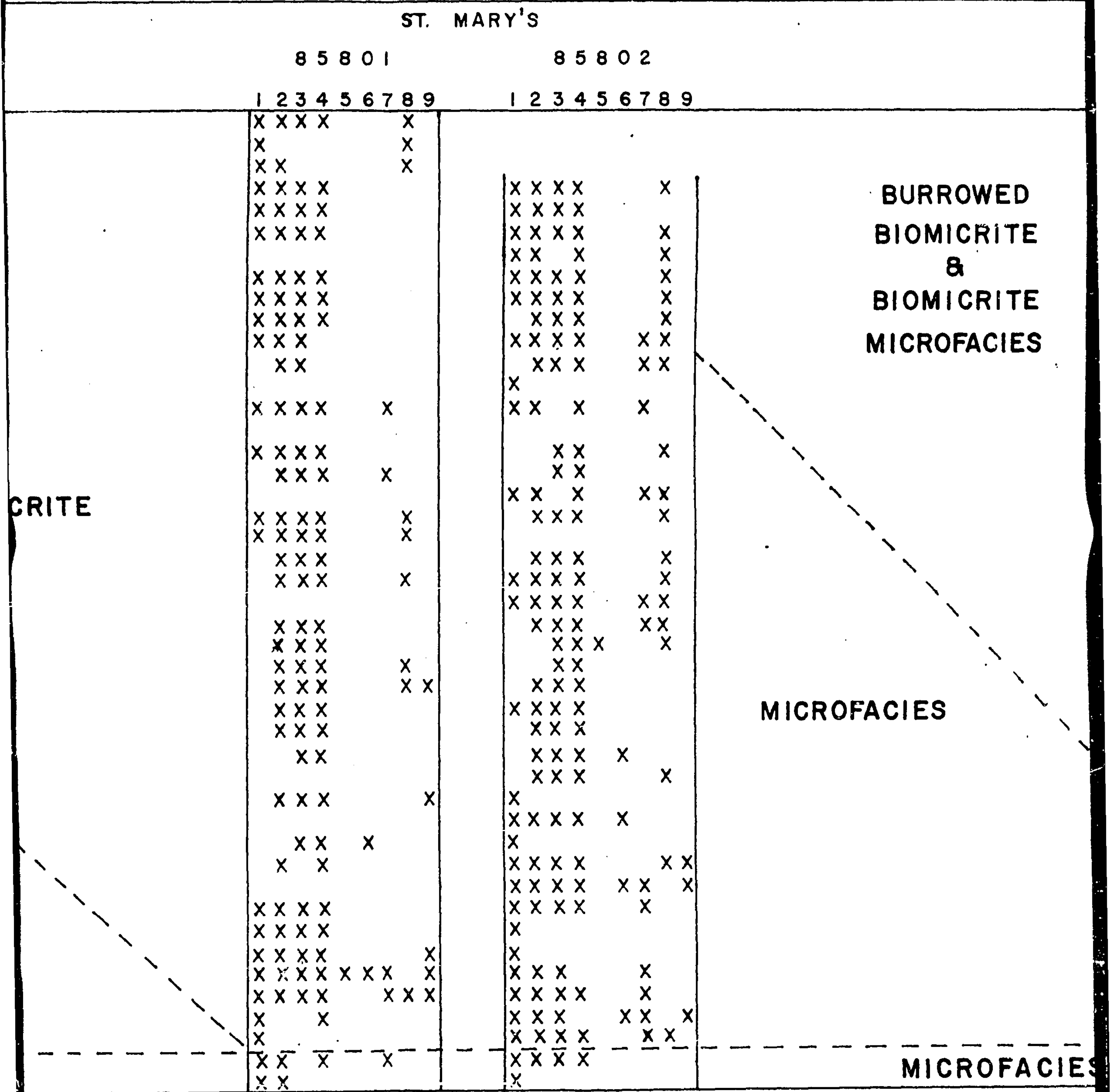


CIES TO
UTION




location
GODERICH
locality no.
8 5 7 9 3
fossil type
1 2 3 4 5 6 7 8 9
NO. OF FEET ABOVE BASE OF UNIT
BIOMICRITE
RECRYSTALLIZED LIMESTONE MICROFACIES
BASAL QUARTZOSE
1 SPORE
2 SCOLECODONT
3 CONODONT
4 FISH REMAINS
5 CRICOCONARID
PROBABL

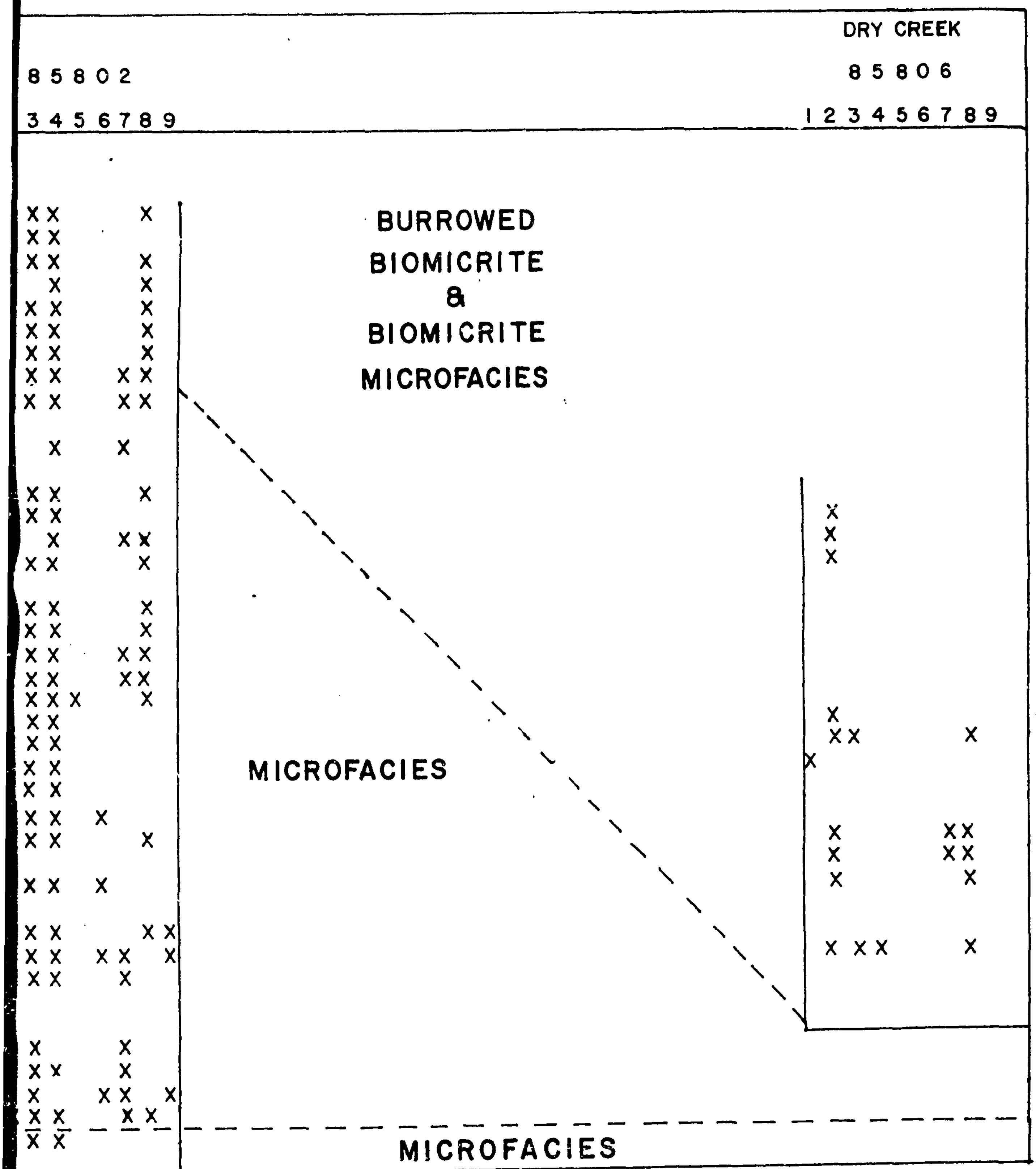
TEXT - FIGURE 15



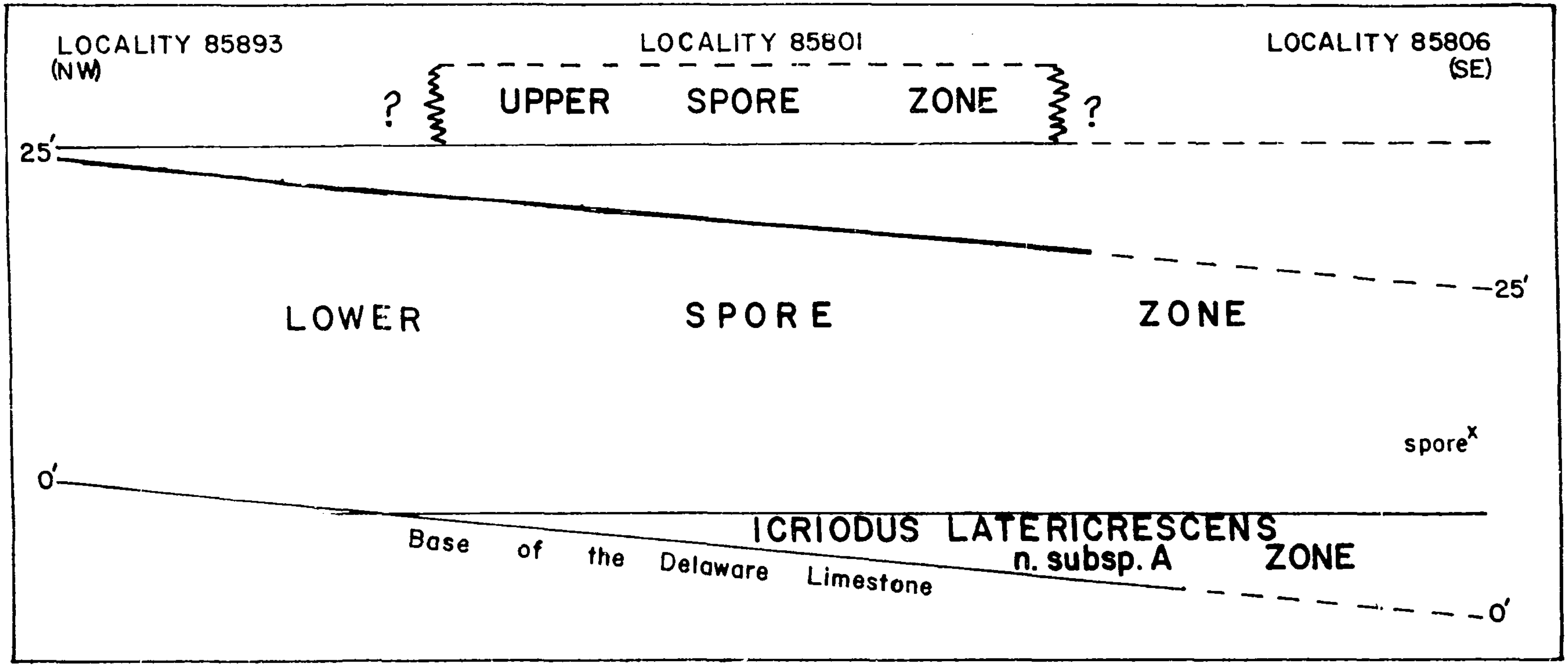
KEY

1 SPORE
2 SCOLECODONT
3 CONODONT
4 FISH REMAINS
5 CRICOCONARID
6 CHAROPHYTE
7 SPONGE SPICULE
8 ARENACEOUS FORAM
9 HOLOTHURIAN SCLERITE
X PRESENT

PROBABLE MICROFACIES BOUNDARY



E
CULE
S FORAM
AN SCLERITE



TEXT - FIGURE 17

ZONATION OF THE DELAWARE LIMESTONE IN ONTARIO

TEXT - FIGURE 18

CORRELATION CHART OF ST

<table>
<tr><th rowspan="2">EUROPEAN STAGES</th><th colspan="3">N. AMER. STANDARD</th><th colspan="7">GEOGRAPHIC AR</th></tr>
<tr><th></th><th>SERIES</th><th>STAGE</th><th colspan="2">NEW YORK</th><th>NORTH CENTRAL OHIO</th><th>CENTRAL OHIO</th><th>MICHIGAN & NORTH-WEST OHIO</th><th colspan="2">SOUTH INDIA</th></tr>
<tr><td rowspan="3">EIFELIAN</td><td rowspan="3">MIDDLE DEVONIAN</td><td rowspan="2">ERIAN</td><td rowspan="2">CAZENOVIA</td><td>MARCELLUS FM.</td><td>CHERRY VALLEY MBR.</td><td rowspan="2">DELAWARE LS.
BENTONITE</td><td rowspan="2">DELAWARE LS.</td><td rowspan="2">DUNDEE LS.</td><td>N. VERNON LS.</td><td>SIL CR
SP ME</td></tr>
<tr><td rowspan="2">ONONDAGA FM.</td><td>SENECA MBR.
TIOGA</td><td colspan="2">JEFFE
TIOG</td></tr>
<tr><td>ULSTERIAN</td><td>ONESQUETHAW</td><td>MOORE-HOUSE MBR.</td><td>COLUMBUS LS.</td><td>COLUMBUS LS.</td><td>DETROIT RIVER GROUP</td><td colspan="2">VIL
L</td></tr>
</table>

Compiled from Oliver and others(1967), Collinson and others(1967), Sanford(1967), Klapper an

TEXT - FIGURE 18

HART OF STRATIGRAPHIC UNITS

AREAS					RANGES OF SELECTED SPECIES
CHIGAN & NORTH- WEST OHIO	SOUTHERN INDIANA		SOUTH & CENTRAL ILLINOIS	SOUTH- WESTERN ONTARIO	
UNDEE LS.	N. VERNON LS.	SILVER CREEK & SPEED MBRS.	LINGLE LS.	? ?	*I. latericrescens* n. subsp. A; *I. angustus*; *Hexagonaria truncata*; *Martiniopsis ? mala*; *Brevispirifer lucasensis*; *Spinatrypa spinosa spinosa*; *Spinulicosta spinulicosta*
	JEFFERSON-		GRAND	DELAWARE LS.	
	TIOGA		BENTONITE	? ? ?	
ETROIT RIVER GROUP	VILLE LS.		TOWER LS.	DETROIT RIVER GROUP	

nford(1967), Klapper and Ziegler(1967), Oliver and others(1969), and Klapper and others(in press)